ELECTRICAL REVIEW

ILLUSTRATED.

A WEEKLY JOURNAL OF

Electric Light, Power, Telephone, Telegraph and Scientific Progress.

VOL. 20. No. 14. WEEKLY. | NEW YORK, SATURDAY, MAY 28, 1892. | $3 per Annum. Single Copies, 10 Cents.

Copyright, 1892, by ELECTRICAL REVIEW PUBLISHING COMPANY, 13 Park Row, New York.

Entered at Post Office. New York, as Mail Matter of the Second Class.

VIEWS, NEWS AND INTERVIEWS.

W. E. Hutton and Isaac Simon, of Cincinnati, created a lot of interest there last week by taking the whole of the second issue of the South Covington and Cincinnati Railway bonds, amounting to $75,000.

A nervous little woman recently boarded an electric car in Champaign, Ill., and spying a bolt in the floor, anxiously said to the ticket taker:

"I suppose this is perfectly safe; but if I should put my foot on that bolt, would I get a shock?"

"O, no, madam," said the conductor, "not unless you put the other foot on the trolley wire at the same time. Let me have your fare, please."—*Street Railway Review.*

A railroad and express agent at Ellaville, Fla., stole a package containing $3,000 and then cut the telegraph wires to prevent pursuit by wire.

When the heathen Chinese, who dwells amid the pleasant vales of Mott street, goes to his breakfast table in the morning he doesn't find a neatly folded newspaper beside his plate, as does his Christian brother. The Chinese who yearns for the news of the day has to go out and consult the neighboring telegraph poles, for it is upon these that those doings of the world calculated to interest Chinatown are chronicled. Little pink and yellow slips, covered with the paresis producing typography of the Celestial, are pasted upon the poles early in the morning, and during the day little groups of Mott streeters gather about them and engage in frantic discussions induced by the perusal of the same. Where these bulletins are printed and who stands the expense of them are twin mysteries. As the time for the election of Chinatown's mayor approaches they multiply until the street looks as though it had broken out with a rash, and those who know say that the language of a dyed in-the-wool campaign organ is childish prattle compared to the remarks on the rival candidates that adorn the aforesaid pink and yellow slips.

Theo. Diffendorf, the telegraph operator, who, with two companions, swindled Saratoga bookmakers out of $23,000 by tapping the wires last Summer, was arrested last week by New York detectives and held for the Saratoga police.

The prospect is that the Engineering Congress, which is to be held in Chicago in 1893, under the auspices of the World's Congress Auxiliary, will be a gathering of very great scientific importance. Of the $15,000 estimated to be necessary for its expenses, $10,000 have been raised. Many of the most prominent engineers of the world have accepted memberships on the advisory council, among whom may be mentioned William H. Maw and James Dredge, of the London *Engineering;* Don Fernandez Leal, president of the Mexican Society of Engineers and Architects; Sir C. S. Gowzski, of Canada, and others.

During a severe rainstorm in Chicago, tents were erected over subway manholes to keep the workmen dry.

Thomson-Houston Development.

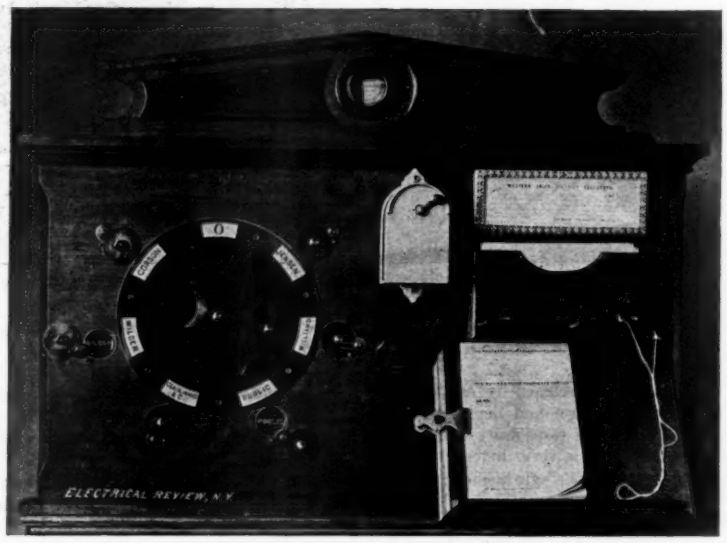
Five years have hardly elapsed since the first street railway was equipped with electric motors, and yet to-day the thousands of electric cars operating successfully throughout the country proved how rapidly and thoroughly electrical propulsion has been perfected. The Thomson-Houston Electric Company in 1888 began the production of electric railway motors and the railway department has been steadily increasing its output until at present over 1,800 operatives are engaged in the production of railway apparatus alone in the Lynn factory.

Improvements are almost continually being made upon the motors. A year ago the noisy "F" double reduction gear type was being made, but now the company produces the single reduction motor with its diminished cost of repair, its simplified construction and proof against injury by water. A year ago the 75,000 watt generator was constructed; to-day the 500,000 watt is a proven success. The factory production involves a weekly pay roll of over $40,000 and the handling of many millions of pounds of material in the course of a year.

The first week of May was the banner week for production in the history of the Thomson-Houston Electric Railway Department. During that week the company shipped 158 motors, which gave the railroads 16 carloads of freight. Including generators sold the railway received 25 carloads of freight.

At the end of last March there were 185 street railways in operation in the United States using the Thomson-Houston system. The number of motor cars used by these railways was 3,010 against 2,941 the previous month, and 2,790 in January. There were 52 roads under contract April 1 to be supplied with the Thomson-Houston electric system, which includes 1,539 motor cars (3,078 motors), and the roads under contract March 1 numbered 35, which includes 1,379 motor cars, or 2,758 motors.

The total number of roads in operation and under contract with the Thomson-Houston Company April 1 was 230 against 222 previous month, and 214 January 15, 1892. The total number of cars for roads in operation and under contract with the Thomson-Houston Company April 1 was 4,569 against 4,319 previous month, and 3,406 January 15.—*Boston News Bureau.*



A NEW MESSENGER CALL SYSTEM.

Providence Telephone Company.

The annual meeting of the stockholders of the Providence Telephone Company was held in Butler Exchange, Providence, on May 11. President Henry Howard called the meeting to order and Col. S. P. Colt was chosen chairman and Charles T. Howard, secretary.

Owing to throat trouble President Howard was unable to make any address and the secretary read some facts submitted by him as follows: The past year has been the same in some respects as previous, although some changes have been made. Matters of importance have occupied the attention of the board to some extent. The subject of underground wires has been considered, and immediate steps should be taken to change the system from aerial to underground. Reference was made to the growth and requirements and the new building to be erected on Fulton street. The plans are now under consideration by the board. Two amendments to the charter have been granted by the legislature, one increasing the capital stock and the other rendering it more complete.

The report of the superintendent shows that there are 4,577 subscribers, an increase of 160 during the year. The old Providence switchboards at Bristol and Pascoag have been changed to multiple boards, and the switchboard capacity of the Providence exchange has been increased 200 lines. During the year 1,024 poles have been set and 725 miles of wire strung, 350 of iron and 375 of copper.

The treasurer's report shows the gross earnings of the company to have been $230,911.71; expenses, $156,911.71; dividend paid, $54,000; amount carried to surplus, $20,000; total surplus, $54,628.60.

It was voted to approve the action of the board in amending the charter, and also to repeal the old by-laws and adopt a new code submitted. The new by-laws differ in two places. First, that the annual meeting shall be held the second Wednesday in February, instead of May, and secondly, that an executive committee shall be appointed.

The following board of directors was re-elected: Henry Howard, Henry G. Russell, Henry C. Cranston, R. G. Hazard, R. M. Larned, J. E. Hudson, James H. Chace, H. F. Barrows, F. H. Peckham, Jr., J. U. Starkweather, Albert O. Morgan and Dexter B. Potter.

New Messenger Call System.

The accompanying illustration gives a very good idea of a neat little device recently patented by Charles B. Perkins and Frank H. Fuller, of Springfield, Mass. These gentlemen have practically demonstrated its utility by actual use for some little time past and intend shortly to put it on the market.

The idea is to inaugurate a new system of messenger call service for use in large office buildings, and the device should prove of great value not only to the telegraph companies, but also to owners of buildings, inasmuch as the mutilation of walls and woodwork, inseparable from the old system of wiring, is entirely dispensed with, to say nothing of the saving in call boxes and the cost and labor of stringing a great mass of wires, which is necessary where each box is supplied with a loop circuit, all the wires entering the building at random. Another great advantage is the fact that the danger from fire through the wires becoming crossed with electric light or other high current lines is reduced to a minimum, and the rate of insurance proportionately lowered.

The working of this system is briefly as follows: One of the panels containing the complete outfit, as shown in the cut, is located at some convenient point in the hallway on each floor, and the dial is numbered to correspond with the number of each room on that floor. There is also a supplementary dial containing a duplicate set of numbers, each one being fitted with a cap which can be thrown to one side, exposing that number, and used in the event of more than one person desiring to send in a call at the same time. Thus, if an occupant of room 50 wishes to call a messenger he steps into the corridor, turns the pointer on the dial to the number of his room and sends the call in the regular way. If another occupant on the same floor wishes to send in a call before the previous one has been answered, and he finds the pointer set to room 50, he throws aside the cap on the supplementary dial, exposing the number of his room, and so on. When the messenger boy arrives he can tell by a glance at the numbers exposed the parties desiring his services. On taking the message he replaces the caps over the numbers, if any are open, and resets the pointer to Fig. 0. These panels can generally be located in the vicinity of the elevator shaft, up which the necessary wires can be run and the connections made with little or no trouble. At the point where the wires enter the building a safety coil is inserted, consisting simply of a coil of fine wire which transmits the current requisite for the dispatch service perfectly, but is burned out at any increase of current which might result from contact with an electric wire at any point outside of the building. An idea of the saving in cost by this system may be had from the fact that in the Fuller building at Springfield, Mass., where the system is now in use, the saving on call boxes alone amounts to $190. That is, under the present system, it requires only five boxes, one on each floor, to render a satisfactory service to the occupants of the hundred offices in the building; whereas, under the old system, with a call box in each room, the expense of the call boxes alone would amount to $200.

A Comparison of Modern Methods of Traction.

Amid the warring of private interests near at hand, it is profitable to turn to some experiences for light upon questions of large public concern. The *Engineer*, London, for March 25 last, makes a useful contribution of this sort to the discussion of street railway power, a summary of which follows. The well-known systems of electrical traction before the public are the following: (1) Accumulators, consisting of the E. P. S., and the Julien types. (2) Overhead, consisting of the Thomson-Houston, Edison, Sprague, Short, Rae, United Electric Traction Company, Daft and Van Depoele types. (3) Conduit, consisting of the Lineff, Gordon and Wynne types for closed conduits; and the Walter Manville and Blackpool types for open conduits.

Although the accumulator system is workable and satisfactory as a mechanical means of traction, it has thus far in England proved a failure in a commercial sense. Its chief defects there are great increase in the tare weight of the car and rapid deterioration of the plates. While it has been abandoned in Brussels, on the Birmingham Central Tramway, it is stated by a report of the directors, issued August 11, 1891, to be a success, but no item is given for depreciation, as compared with other methods of traction. The following table gives the working expenses per car mile for the four different systems of traction in use by this company: Working cost per car mile with steam, 21.98 cents; working cost per car mile with horses, 19.58 cents; working cost per car mile with cable, 12.66 cents; working cost per car mile with electricity, 19.80 cents.

The overhead or trolley system is in operation in Leeds, where the corporation has lately granted an extension of the system, attesting at least its popularity. The whole of the electrical work was supplied by the Thomson-Houston Company of America. Within the last few months such towns as Walsall, Leeds and Bradford, have assented to its adoption in their outskirts. It is, without exception, the cheapest in initial cost, but the working expenses, though less than those of accumulators, are not necessarily less than the working expenses on the conduit system of electrical traction.

The following comparison is made of the working expenses of electrical street railways in England and America as against horse traction. In America the average working expense of horse tramways is 79 per cent. of the gross earnings. The average working expense of horse tramways in England, according to the Board of Trade returns, is 77 per cent. of the gross earnings. The largest street railway system in the world is the West End, Boston, Mass. Electric traction is fast supplanting horse traction on this line. In June last the mileage proportion between horse cars and electric cars stood at 3 to 1. The operating expense by horse traction was 66.70 per cent. of the gross earnings, while that of electric traction was 47.70.

The returns of the Boston system are analyzed, with the result of finding that the net earnings per car mile of the electric system over the horse system is 9.96 cents. There are two reasons for this: (1) Economy of working, and (2) increase of traffic, due to what may be called "public satisfaction." If this amount is divided into two parts, one part representing the former and the balance the latter, we find that the operating expenses of the horse line exceed those of the electric by 3.84 cents per car mile. Subtracting the difference of earnings from the difference of expenses, the result is 6.12 cents per car mile, which amount represents the net profit of electric lines over horse lines due to "public satisfaction."

The conduit system is less fruitful in working results for lack of successful examples. The conduit is of two types, the closed conduit and the open conduit. Experience with the first develops three grave objections: Firstly, the necessity of putting short lengths of surface rail temporarily into circuit by means of some electro-magnet device, appears too complicated to be reliable in working. Secondly, the practical impossibility of making such a system thoroughly insulated in a street subject to heavy traffic; and, thirdly, supposing these two difficulties to be overcome, the impossibility of insuring a proper contact when the road is covered with water, dirt or snow, and the impracticability of laying short lengths of rails with sufficient rigidity in a street where there is heavy traffic. Until further practical demonstrations of its working are forthcoming, it is useless discussing it any further.

The main objections to the open conduit in the past are perhaps on the point of being obviated now by a system called the Walter Manville, in which, we are told, the experience of a practical tramway engineer has been combined with the experience of a practical electrician to produce a form of conduit traction superior to any other. The conductor being a flexible cable or wire, it requires fewer supports than in the case of a rigid conductor, and these supports are situated in chambers covered with hatches similar to, though smaller than, those in use on cable tramways. The conductor, being flexible, can be taken out or replaced through the slot without interfering with the conduit, which is impossible in the old systems of this type.

The *Engineer* proceeds next to a comparative estimate of which, though some of the actual figures may need to be changed in meeting American conditions, the principle is irrefragable. The argument is, therefore, given in *extenso*. The pound sterling is, for convenience, converted to American units at $5 to the pound.

Being entirely governed by capital cost, working expenditure and depreciation, a hypothetical case of three miles of tramway is taken, and as it is very difficult to apply the cable system to a single line with passing places, a double track example is taken, and one gradient of 1 in 20,880 yards long in the center of the system is assumed. It is proposed to furnish the same with an equipment sufficient for a ten-minutes' service by horse, cable or electricity, including the overhead and conduit systems. The capital cost and average working expenditure of each system has been carefully compiled from such detailed information as has been obtainable, and is verified by the author's own personal knowledge and experience.

In the estimates of capital cost any allowance for depot buildings and land has been excluded, as, although the figures would show somewhat in favor of mechanical systems, they might be taken for this purpose as costing about the same in each case, and as the value of land varies in different localities, and the cost of a depot is a very variable item in accordance with the class of work which may be put into it, it is better on the whole to exclude this item. The capital cost expended on the construction and equipment of a horse line may reasonably be taken at $129,000, of which $105,000 represents the cost of the tramway and the balance the equipment.

In dealing with the mechanical system it is assumed that the cost of the construction of a horse line should be added to the cost of converting the line and equipping it on the respective systems of mechanical traction, and it has not been thought fair to charge these systems with any portion of the cost of the horse equipment, because the equipment should represent its full original value if a proper sinking fund has been provided, and on this basis the capital cost of horse, cable, overhead and conduit lines is estimated as follows: Capital cost of horse line, $129,000, exclusive of depot; capital cost of overhead line, $160,000, exclusive of depot; capital cost of conduit line, $207,500, exclusive of depot; capital cost of cable line, $240,000, exclusive of depot.

In regard to the working cost of these systems, the figure put down—which, in each case, includes a reasonable allowance for maintenance and repairs—has been arrived at, as regards the horse line, from the large amount of information which is available on the subject. As regards cable traction, the last balance sheet of the Birmingham Central Tramway Company's cable system has been taken, and the figures which they give have been adapted to the example given. It is necessary to point out that the efficiency of a cable tramway depends in an exceptional degree on the car mileage, which in Birmingham is very large. The figure arrived at in this case has been checked by reference to American statistics and by other means, and it may be considered as a fairly accurate estimate.

At any rate, it would not be safe to assume that a cable line of this size, and with the specified service, could be worked at a cheaper rate than that given later on. In the two electrical systems the actual details of the cost which would be involved has been very closely gone into. The estimates given are very sufficient, and there can be no reasonable doubt whatever that such a line could be worked at the price stated. There is no appreciable difference in the cost of working an overhead and a conduit system. It should also be stated that these estimates, besides including maintenance and repairs, as above stated, also include the cost of the car drivers, which is a very considerable amount, and is not infrequently omitted in estimates of cost of traction. The following are the figures, the rate per car mile being based on car mileage of 197,000 per annum:

	Per annum.	Per car mile.
Cost of working horse tramway..	$28,750	14.0c
Cost of working cable tramway..	28,750	14.0c
Cost of working overhead tramway.....	16,000	7.8c
Cost of working conduit tramway.	16,000	7.8c

In order to compare the relative conditions of working with horse or with one of the mechanical systems referred to in the preceding estimates, it is assumed that in order to raise the extra capital required for each of the mechanical systems over and above the capital necessitated for a horse line, that debentures must be issued at five per cent., so that the original capital for all the systems will be the same as for a horse line, and this capital has been taken at $175,000, being an extra sum of $46,000 to cover cost of depots and working capital beyond the figure of $129,000 included in the preceding estimate. The amount of debentures to be issued would, therefore, be as follows:

Overhead line, $36,000, equal, at five per cent., to $1,550 per annum.

Conduit line, $78,500, equal, at five per cent., to $3,925 per annum.

Cable line, $111,000, equal, at five per cent., to $5,550 per annum.

The debenture interest must, therefore, be added to the working cost of each of the mechanical systems in order to compare them directly with a horse line. We, therefore, have the following figures of working cost:

	Ordinary working cost.		Debenture interest.		
Overhead line.....	$16,000	+	$1,550	=	$17,550
Conduit line.....	16,000	+	3,925	=	19,925
Horse line.....	28,750	+	——	=	28,750
Cable line.....	28,750	+	5,550	=	34,300

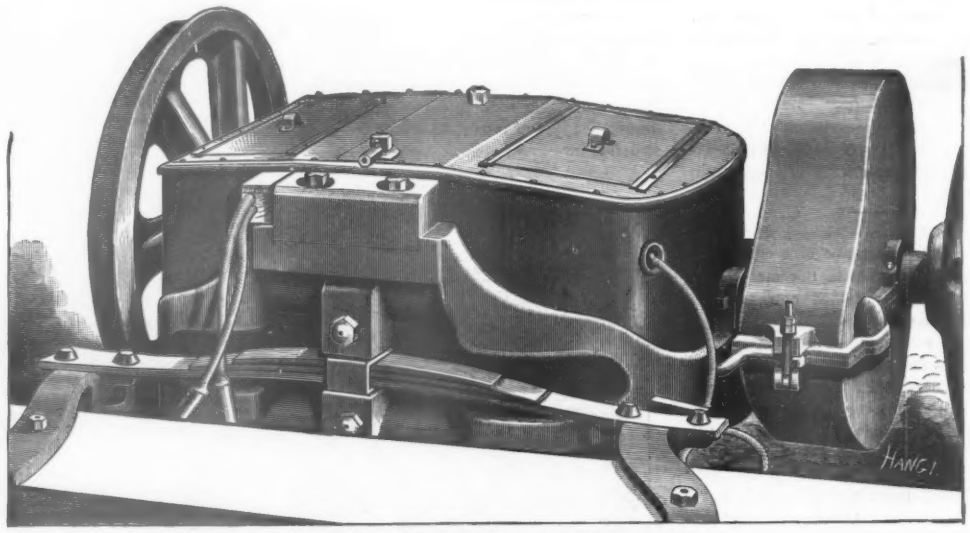
These preceding figures show that for a line of this description a cable tramway is more expensive to work than a horse line after making provision for the debenture capital involved by the cost of reconstruction. The following figures show the amount saved per annum by the overhead and conduit systems compared with a horse tramway:

Overhead.....	$28,750—	$17,550=	$11,200
Conduit.....	28,750—	19,928=	8,825

And these amounts show an increased dividend available on the ordinary share capital, $175,000, upward of six per cent. per annum in the case of the overhead line, and upward of five per cent. per annum with a conduit line.

An Improved Wightman Motor.

The Wightman Electric Manufacturing Company, of Scranton, Pa., have had their street railway system on the market for some time, but recent improvements in the motor construction have made the system even more valuable. Several improvements relate to the protection of the field windings and the working parts of the motor against external injuries. The motor shown in the accompanying illustration is of a new type and of 25 horse-power. It is entirely encased in steel armor, making the motor dust and water proof, and still allowing ample ventilation. Easy access to such parts as require frequent inspection is afforded by the casing, which is made of sheet steel riveted to the motor frame. This greatly increases the strength of the motor without adding necessarily to its weight. The motor gear case as now made is of malleable iron in three parts and very easy to attach or take off. It is perfectly dust proof, and the parts are so joined that it is impossible for them to work loose. The controlling switch used with this motor is of the standard Wightman type, having the speed controlling handle and the reversing handle combined in one, making the operation of a very simple character. No external resistance is used with this controlling device above a car speed of three or four miles per hour. There are five speed contacts possible for each direction of operation. Under recent severe tests in competition with other well known systems the Wightman motor gave very flattering results. The Wightman Electric Manufacturing Company, among other recent orders, have secured the contract for 20 car equipments and a 300 horse-power generator for the Sea Shore Railway Company, at Asbury Park, N. J.



IMPROVED 25 HORSE-POWER WIGHTMAN RAILWAY MOTOR.

Sparking and Flashing of Dynamos.

READ BEFORE THE CHICAGO ELECTRICAL ASSOCIATION MAY 10, 1892, BY F. R. M'BERTY.

Prominent among the faults of the continuous current dynamo is its tendency to spark and flash at the commutator.

The consideration of these phenomena does not seem to have had the place in electrical literature that their importance deserves, although not a little of the study of every dynamo designer has been in the direction of lessening the tendency of the machine to spark and to devising means for reducing the destructive effects of the spark to a minimum when it was unavoidable. These efforts have been successful in varying degrees, but not infrequently the absence of spark has been attained by a departure from the best design in other respects.

Probably every designer has a sort of working theory of the cause of sparking and flashing, but it is only at rare intervals that any information on the subject escapes to the outside world, and then at most only hints of the truth. It is noticeable that the thorough and earnest students of electrical phenomena and of the details of electrical construction are usually those who are so for commercial reasons, and who have little time or desire to publish the results of their work. There is a vast amount of electrical lore shelved in work shops and jotted in note books. So it happens that no satisfactory or complete theory of the causes of sparking and flashing in dynamos has been made public.

It is the privilege of the writer to present such a solution of the problems connected with these phenomena, which seems to be so sufficient and of such obvious application as to rise out of the catagory of theory into that of accepted explanation. This solution was arrived at by the consideration of the conditions actually existing in the armature coils, due weight being given to the effects of self-induction, and to the short-circuiting of the coils by the brushes; and for this reason it is consistent throughout with the facts which it seeks to explain.

It has been frequently assumed that a dynamo, well designed in all particulars, would run without spark at the brushes, and hence, that the presence of a spark was *prima facie* evidence of incorrect design. This assumption is, however, too general to be strictly in accordance with the facts; for while in certain types of dynamos, notably the constant potential, low voltage machines, the spark may in most cases be wholly avoided, in another type, the high potential constant current machines, the absence of spark is attained only at the expense of complication of structure and irregularity of action. Of this latter type of dynamos, then, the most successful commercially seem to be those in the designing of which the spark has been chosen as the lesser of the evils, and is reduced by careful adjustment of the brushes, or by other means, to such character as to be as little troublesome and destructive as possible.

In the constant potential dynamos, or, more generally, in all dynamos having low armature resistance and self-induction, it is not difficult to wholly avoid the spark by appropriate design. When the spark does occur, it is usually caused by sudden large change of load or of speed, shifting the diameter of commutation by the reaction of the armature upon the field; it then disappears immediately upon the adjustment of the brushes to a new and corresponding position upon the commutator.

In dynamos constructed to supply constant current, on the other hand, some resistance and considerable self-induction of the armature appear to be necessary to the stable operation of the machine; and as the appearance of spark at the brushes is largely determined by the possession of these qualities by the armature, it follows that a satisfactory constant current dynamo which does not spark at the commutator is something of a *rara avis*. It is true a large variety of successful constant current dynamos have been constructed having armatures of comparatively low resistance and self-induction; in fact, it would seem to be easier to construct a satisfactory dynamo of this variety than of the other, constructing the armature with a large number of coils and a small number of turns to the coil. One disadvantage of this construction lies in the large expense of commutators for such armatures; but a more serious one is found in the character of the circuit and translating devices which it is to supply.

Dynamos of the constant current type are usually designed to furnish current to arc lamps in series. With carbons even the best obtainable arc lamps are unsteady and varying in their action. Every impurity in the carbon of any lamp in the circuit causes a change in the volume of the current, which tends to affect in every turn every other lamp in the circuit. Arc lamps may, for the present purpose, be divided into two general classes, those whose regulating mechanism consists of or comprises a wheel train and escapement, by which a gradual and steady feed of the carbons is procured, and those whose regulating mechanism is only a series of levers acting to communicate or allow movement to one of the carbons through a clutch in immediate and direct response to changes of strength of electromagnets. Most of the lamps in which wheel train regulating mechanism is employed do not respond at once to sudden changes of current, and hence have a less unsteady effect in the circuit. The sluggishness of response of the lamps in the circuit prevents the disturbance of the whole series by an irregularity of burning of one lamp.

Generally, the lamps of the second class are quick to respond to changes in the strength of current through them. Hence a sudden variation of the current by an increase or decrease of one arc affects the other lamps in the circuit. The effects upon the current in such a case are cumulative, since the sudden response of the whole series of lamps causes a variation in the current much greater than the original increase or decrease.

These considerations would seem to point toward the first class of lamps, the wheel train regulators, as those more likely to be satisfactory in operation. This would unquestionably be the case if only the conditions presented were considered, but there remain several other factors which enter into the determination of the commercial value of a lamp. These are foreign to the subject and hence need not be dwelt upon at length here, but a few may be enumerated. Thus, the wheel train regulating lamps are in most cases more expensive to construct and repair, and more difficult and troublesome to keep in order, than the simpler lever-regulator lamp. Then, to a mechanical mind, the employment of a system of a few pivoted levers and links appears a more direct and desirable mode of arriving at a result than through the medium of gear wheels, ratchets, racks and pinions. And, lastly, the quick responding regulator is able to compensate for irregularities in its own carbons, disregarding the others of the circuit, and to preserve its own steadiness of light better than one more sluggish to respond.

Assuming it to be granted that the quick regulating lamp has a right to exist, it becomes desirable to provide some means for preventing great and sudden changes of current strength on account of changes of circuit resistance. The simplest and most efficacious means to this end consists in the inclusion in the circuit of some additional resistance, or of a coil of wire having considerable self-induction, or preferably both; and these are found most economically provided by the field and armature coils of the generator itself. Thus the dynamo, having few armature coils of many turns, of high self-induction and some resistance, is offered as the most efficient generator for supplying current to a large and successful class of arc lamps. An understanding of the cause of the spark which is constantly present at the brushes of such a machine and of the methods of decreasing the spark to a minimum thus becomes of primary importance.

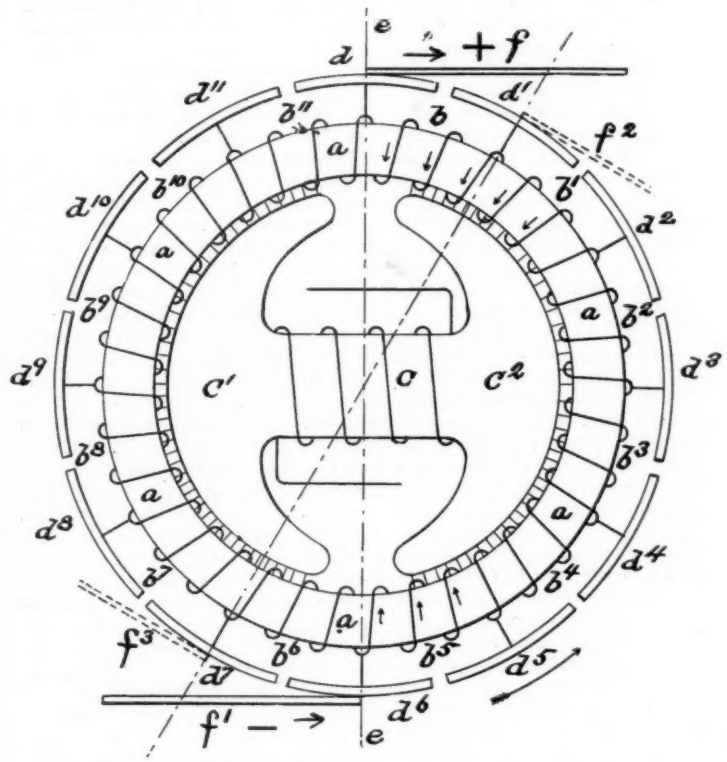


FIG. 1.—TYPE OF DYNAMO MENTIONED IN "SPARKING OF DYNAMOS."

The subject of sparking is brought into prominence from another standpoint—that of the current regulation. For varying the electromotive force to obtain regulation to constant current, the method of shifting the brushes on the commutator has long been accepted as the only entirely successful and efficient way. But this method is successful and efficient—is, indeed, possible—only under certain rather undefined conditions. Under some conditions of field distribution it is impossible to shift the brushes from one point to another, to vary the difference of potential of the brushes, without obtaining a spark or a flash of such character as to render it destructive to the machine to allow them to remain in that position. Again, with a certain degree of span of the brushes upon the commutator, only a certain definite current can be taken from the machine without injurious sparking or flashing, and, conversely, to obtain any given current without injurious sparking, a certain degree of span must be given to the brushes.

Thus there exists a definite relation between current regulation and sparking at the brushes. Indeed, it will be obvious from the causes of sparking that under certain readily obtainable conditions of field distribution regulation to constant spark is regulation to constant current, or *vice versa*. The apparatus may then be adjusted to carry the minimum spark obtainable for the current required, when the spark will not be increased or a flash produced as long as the current is maintained constant.

Since it is in dynamos having armatures of high self-induction and resistance that the sparking becomes most conspicuous, this type of machines may be taken as an example, in which the phenomena may be studied and their causes noted. Of these the simplest to study and follow is a machine having a Gramme ring or drum armature of a few coils, say, for instance, twelve. The application to other machines of the explanation, once arrived at, is simple and easy. Consider, then, the actions taking place in the armature, commutator and brushes of a dynamo having a Gramme ring armature of twelve coils, each coil being of a large number of convolutions.

In Fig. 1 is shown a Gramme ring armature having a circular iron core a. Upon this are wound the twelve coils b, b^1, b^2, b^3, etc. The field is set up by the field magnets c. A rather unusual form of dynamo is here shown, in order to obtain clearness of the diagram; the fields are placed inside the ring armature, the lines of force extending radiately from the pole pieces c^1, c^2, to the iron of the armature. The terminals of adjacent coils are connected to segments d, d^1, d^2, etc., of the commutator, outside the armature. The armature and commutator may be conceived to revolve as usual, and in the direction shown by the arrow, the fields being stationary.

It is not wholly necessary to follow the well known process of generation and collection of current in an armature of this type, but a brief description of its operation in general may be permitted for the sake of completeness and to afford an opportunity for definition of certain terms.

When the armature is rotated, as shown, the coils b to b^5, inclusive, cut lines of force radiating from the pole piece c^2 of the field, in such direction that there is induced in each of the coils an electromotive force tending to send current through the coils from the segment d^6 to the segment d of the commutator, and thus producing a difference of potential between the segments d^6 and dd, being positive to an external circuit and d^6 being negative; the coils b^6 to b^{11} on the other half of the armature are cutting the oppositely directed lines of force passing into pole piece c^1 in the opposite direction, and each of these coils has an electromotive force induced in it also tending to produce current through the coils from segment d^6 to segment d, and setting up a difference of potential in the coils between those segments in the same direction as before, the line ee, in passing which a coil cuts the last of the lines of force in one direction, that is, from one pole piece, and begins to cut the oppositely directed lines of force from the other pole piece, is termed the neutral line. A coil of no breadth passing this line would have no electromotive force induced in it at that instant.

The brushes ff^1 may be placed to bear upon the commutator segments dd^6, and thus to supply current to an external circuit. The diameter, at the extremities of which the brushes are placed, is termed the diameter of commutation; in this case it coincides with the neutral line.

The brushes, when placed at this position, obtain the utmost difference of potential set up in the armature. They are at the position of theoretical maximum E. M. F.

If the brushes be moved to rest upon any other segments of the commutator, the difference of potential between them is diminished. Thus suppose them to be placed upon segments d^1 d^7, as indicated by

dotted lines f^2 f^3. The current set up by the same directed electromotive forces in coils b^1 to b^5 is opposed by the oppositely directed E. M. F. in coil b^6, and in the other half of the armature the same directed E. M. F.'s of coils b^7 to b^{11} is opposed by the oppositely directed E. M. F. of coil b.

The difference of potential between the brushes f f^1 is thus reduced from two causes; one is that the number of coils contributing to build up an E. M. F. in a particular direction is decreased from six at the former position to five at the present position; the other is that the generated E. M. F. of the five active coils is opposed by the oppositely directed E. M. F. of a coil which formerly belonged to the oppositely directed half of the armature, but which has now been interposed in series with the other half.

In the same manner the brushes may be moved still further to obtain a still greater decrease of difference of potential between them; when they have been placed so that the diameter of commutation is at right angles to the neutral line, half of the coils of each half of the armature have electromotive forces opposing those of the other half of the coils of the same half of the armature, and hence no difference of potential is set up between the brushes.

Obviously, a continuous decrease of difference of potential between the brushes, from the maximum to zero, may thus be obtained by shifting the diameter of commutation from a position coincident with the neutral line to one at right angles with it. Since the neutral line is practically stationary in space, the line of demarkation between differently directed electromotive forces is not confined to the terminal coils, but may be situated at any place in one continuous coil, so that any portion of one coil may be made to have an electromotive force, proportional to the size of the portion, opposing the electromotive force generated in the complementary portion of the coil.

This is the ideally simple current regulation. In practice, new conditions at once arise which complicate the operation and the means of regulation; these new conditions are the causes of sparking and flashing.

The principal of these unconsidered obstacles to ideal regulation is the self-induction of the armature.

Referring now to Fig. 2, which represents the upper brush and a small portion of the armature, trace the operation of the armature as modified by self-induction. Suppose the circuit of the brushes to be closed and the machine to be generating current of say 20 amperes. This current is being produced by the two halves of the armature, placed in parallel, so that each half of the armature is carrying a current of 10 amperes.

There is then a current of 10 amperes flowing in the coil b while it is in the position shown; it is transmitting 10 amperes of current and also generating a slight electromotive force in the same direction. As it nears the neutral line its own electromotive force decreases until just at the neutral line it is zero, but the current remains the same. Suddenly the brush passes off from the segment d and on to the segment d^1, transferring the coil b as suddenly from the circuit of current in one direction into circuit of current in the opposite direction. The self-induction tends, and indeed acts, to prevent this sudden reversal of circuit in coil b. During the first instant after the coil b has been transferred into its new circuit, the current which has been flowing from segment d directly to brush f meets a very large counter electromotive force; hence, instead of taking the new path through the coil b to brush f, the current forms an arc from the tip of the brush to the edge of the receding segment d.

The counter electromotive force of coil b dies away very rapidly, however, partially by natural expenditure and partly because, having crossed the neutral line, it is already beginning to cut lines of force in the opposite direction; soon the segment d may arrive at the same potential as the brush, when the current will take the new course through the coil b to the brush, and the arc will become extinguished. The spark at the brush is then not a spark in the usual sense of the term—that of a disruptive discharge—but it is a true arc of momentary duration, lasting just as long as the electromotive force which sustains it continues.

This arc will be lasting in proportion to the self-induction of the coil b, or rather to the length of time which is required for the segment d to acquire a potential equal to that of segment d^1, which time is determined by the self-induction of coil b. If this be so great, or if the normal difference of potential between segments occupying the positions of segments d and d^1 be so great that the time required for the segment to arrive at the potential of segment d^1 is greater than the time required by the segment d to advance through the width of the space separating the segments d and d^1, the arc will follow the receding segment d until the forward edge of segment d^1 reaches the tip of the brush, when the arc will be transferred to that edge, and will then play be-

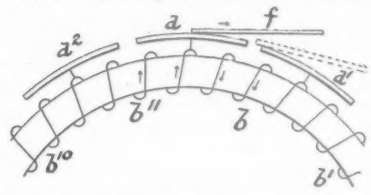


FIG. 2.—SPARKING OF DYNAMOS.—UPPER BRUSH AND PORTION OF DYNAMO.

tween the adjacent edges of segments d and d^1, and will persist as long as there exists sufficient difference of potential to maintain an arc. A second arc will also be formed between segments d and d^1, and between all the rest as each succeeding segment passes under and away from the brush. There is thus produced what is technically known as a "flash," which partially encircles the commutator, short-circuiting several of the coils.

If an attempt were made to move the brushes forward in the direction of rotation to accomplish a diminution of the difference of potential between the brushes, the reaction leading to the formation of the arcs or flash would be somewhat diminished up to a certain point. Suppose this movement forward from the neutral line to take place. The electromotive forces acting to send current through the coils is diminished, reducing the strength of the current and thus reducing the opposing electromotive force of the coil which is being suddenly introduced into the other half of the circuit, and at the same time accomplishing this introduction while the coil is in a part of the field at which it is cutting lines of force tending to oppose its opposing electromotive force—that is, in the direction to start a current in the coil in the same direction as the current which is compelled to flow through it. Hence the movement when the segment which has just left the brush and that which has just come under the brush will be at equal potentials is hastened, and the arc persists for a shorter time; it may thus become a smaller and smaller spark as the brushes are moved away from the neutral line, although it is at no time inconsiderable. When the diameter of commutation has become at a right angle with the neutral line the potential difference of the brushes is zero; there is then no current and no spark. This method of reducing spark is, therefore, not a commercial success.

When an attempt is made to regulate by moving the brushes backward from the neutral line, the reactions tending to produce the flash are intensified, because the transferred coil is cutting lines of force in a direction to assist instead of diminish its opposition to change of direction of current through it.

It is, therefore, impossible to operate a dynamo of this type with brushes touching the commutator only at one point, and if its operation were possible, it would still be impossible to regulate the electromotive force of the dynamo by shifting the brushes.

The remedy lies in so constructing the brushes, or in providing an additional pair of brushes so disposed as to continue the contact between the brushes and the commutator segments constituting the terminals of the coil which is about to have the direction of its current sufficiently long that the current arising from its self-induction may have time to die out, and that current in the opposite direction may have time to build up. This last condition requires some explanation.

It is evident that a portion of a circuit carrying a given current may be introduced into another circuit carrying an equal current in the same direction, without spark or disturbance of any kind. It is practically joining points having no difference of potential, by means of a conductor. The operation may be conveniently studied in the diagram, Fig. 3.

This diagram represents a circuit containing apparatus organized so as to be substantially equivalent to the conditions which obtain in a dynamo. The sources of electromotive forces are represented by batteries, and the self-induction is provided by a suitable coil. There are here shown two circuits—one is the circuit h, h^1, h^2, including a self-induction coil i and a battery k. The other is the circuit l, l^1, l^2, including the battery m and resistance n. When the resistance of circuit h, h^1, h^2, is such as to produce current equal to that in the circuit e, e^1, e^2, the brush or contact point p may be raised from or closed upon the segment or contact anvil o without causing any spark at the break, because there is no difference of potential between the segments o, o^1; the act is in effect opening the bridge wire of a Wheatstone bridge when it has been adjusted to no current through it.

This result may be obtained in a dynamo by causing the brushes to cover a proper portion of the circumference of the commutator; the sketch may then be considered as representing the conditions which must be attained. In that case the diagram shows the segment o in the act of passing out from under the forward or leading brush p; the battery k represents the electromotive force in the short-circuited coil, the battery m that in the remainder of the coils. In order to be able to move the segment o out of contact with the brush p without creating an arc, the current in circuit h, h^1, h^2 must be equal to the current in the circuit into which it is to be introduced.

In Fig. 4 is shown a series of five figures, v, w, x, y, z, each of which shows a portion of an armature and commutator, and a compound brush constructed to span about a twelfth of the circumference of the commu-

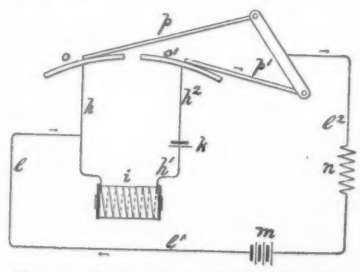


FIG. 3.—SPARKING OF DYNAMOS.—DIAGRAM OF SUGGESTED EXPERIMENT.

tator. The segments are shown in successive stages of advancement under the brushes, in order that the successive conditions and actions of a coil may be traced during its transference from one-half of the armature circuit into the other. In v the segments d^1 and d^2 are shown just before passing under the brushes p and p^1, respectively. The coil b^1 is then in circuit with the right half of the armature and is carrying current—say, for example, 10 amperes—in the direction shown by the arrows. An instant later the segments d^1 and d^2 have passed under the brushes p and p^1 into the position w. The coil b^1 is now short-circuited; for an instant the self-induction of the coil causes or tends to cause a continuation of the current in it in the same direction, but this electromotive force is rapidly diminished. The magnetic field of the current quickly expends its energy in the coil b, and the rapidity of its decrease is heightened by its having already begun to cut lines of force in the opposite direction, until, by the time it has arrived in position x, the current or electromotive force of self-induction has become *nil*. In order to attain the conditions described in connection with Fig. 3, which are necessary in order to break contact between the segment d^1 and the brush p without causing an arc, it is required to have set up a current in the short-circuited coil b^1 approximately equal to the current which is about to pass through it, and in the same direction. To do this the coil b^1 must already have begun to cut lines of force on the left side of the neutral line sufficient to set up such a current. But if the brushes were so set that the two prongs p and p^1 touched the commutator at equal distances on opposite sides of the neutral line, the two halves of the coil b^1 would be cutting lines of force in opposite directions, and no current could be generated in it.

For this reason the brushes must be placed a little forward of the neutral line, in order to fulfill the conditions necessary to prevent sparking.

The neutral line in x of Fig. 4 is indicated by the dotted line a little behind the rear brush p^1.

In position y, then, the cutting of lines of force on the left of the neutral line by the coil b^1 has created a current of substantially 10 amperes. At that instant the segment d^1 passes out of contact with the leading brush p. There is at that instant no current in brush p, and in consequence of the fulfillment of the required conditions the separation is made without the formation of any arc, or, as is usually expressed, without spark.

It must, however, be acknowledged that the requirements are rarely perfectly fulfilled, and that in consequence the brushes rarely run perfectly clean. But the spark may be reduced to such smallness that its effect upon the brushes and commutator is scarcely perceptible.

The coil b^1 is thus introduced into circuit with the coils in the left side of the armature and receives and transmits the current of the circuit as if it possessed no self-induction whatever.

Obviously, the time required for the coil b^1 to lose its self-induction current is not adjustable, nor is the time required for the new oppositely directed current to become of proper volume; but the time allowed for these effects to take place may be varied by varying the length of time during which the coil is short-circuited by adjusting one or both brushes p p^1 so as to enclose or span more or less of the commutator.

If any increase of the current in the main circuit occurs, the time during which the coil about to be transferred must be short-circuited must be correspondingly increased because the increased current requires a greater time to become decreased to zero before the current in the other direction begins to be built up. From this it results that the current in the short-circuited coil will be deficient in amount, and a spark of greater or less length will be produced at the tip of the brush as described; this spark or arc will, however, persist only for a moment until the current in the newly introduced coil has reached its normal value. On the other hand, if a decrease in the current of the external circuit takes place, the self-induction current in the short-circuited coil expends itself too quickly, and the reverse induced electromotive force reaches too great an amount at the moment when the segment d^1 leaves the brush p. There is then a current flowing from segment d^1 to the brush p, and this current forms a spark or arc which persists, growing larger as the coil is made to cut an increasing number of lines of force, and thus forming the well-known flash encircling the commutator.

The spark formed in the first case may, of course, be taken up by increasing the spread or span of the leading and following brushes, until the short circuit is maintained about the "about to be transferred" coil the proper length of time to obtain the minimum spark. In case of decreased current, the spread of the brushes may be decreased,

until the amount of the "built up" electromotive force, is just equal to the current in the coils, into series with which it is to be transferred, thus reducing to a minimum the spark or arc which causes the flash. Neither of these possible adjustments is often used in practice, however. The object is usually not so much to avoid sparking or flashing as to keep the current constant, and when the current has been returned to its normal value, the spark or flash will disappear because the conditions determining its absence have been re-established. Regulation to constant current is, then, regulation to constant and minimum spark, and *vice versa*. Moreover, for every current there is a best spread or span of the two parts of the compound brush, and for every given span of these parts there is a certain current at which no flash will occur, and at which the minimum spark will exist.

In order to secure regulation of the current by rotating the brushes upon the commutator, the field must be evenly distributed and uniform, so that in whatever position between the maximum point and the neutral line the coil may be short-circuited, it will cut the same number of lines of force during the time when it is short-circuited. With a field of the character described, the brushes may be placed in any position upon the commutator, provided only that it be before or in advance of the neutral line, where they will take up the proper current without a flash or injurious spark.

This regulation can be accomplished only by a movement of the brushes in advance of the neutral line, however. If it be attempted to move the brushes back of the neutral line, to reach a position of lower electromotive force, the short-circuited coil will at all times be cutting lines of force in a direction to continue and increase the self-induction current, instead of bringing it to zero; and when the moment arrives in which contact between the forward segment of the short-circuited coil and the leading brush is broken, a heavy arc will be formed, which will be transferred to the space between the commutator segments and will persist until the coil which is furnishing the current has reached the neutral line.

If it be attempted to run a dynamo of this character upon open circuit with the fields excited, a constant flash will be produced at the commutator. As each coil is short-circuited, it at once has a considerable current set up in it, and when its forward terminal passes out from under the brush an arc will be produced and will persist as the coil passes through the field, and until it has reached the other brush.

The subject is by no means exhausted, but it is thought that the preceding consideration of the case in which sparking and flashing are most prominent and frequent, and coincidently the causes of these phenomena are present in the greatest degree may furnish an obvious explanation for the simpler cases.

Protection by Telegraph.

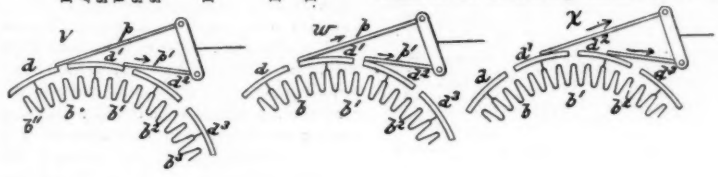
Since the telegraph has been brought to about as near the point of perfection as it is likely to attain, and telegraphic communication has been established to the remotest parts of the world, it has become very difficult for rogues to escape its searching ways. Once in a while a fugitive from justice manages to elude his pursuers, but if the party sought is of sufficient importance to be in special request, his whereabouts are likely to be discovered. One of the most notable instances of failure in that respect on record is that of Marsh, late president of the Keystone bank, Philadelphia, who has thus far managed to elude arrest, but it is generally conjectured that if certain parties desired his presence his present home could be readily determined. Among the many instances of the detective powers of the telegraph is the discovery of the whereabouts and the arrest of Rudolph Jaeger, the Rothschild runaway cashier, who fled, leaving behind him a defaulting record amounting to 1,700,000 marks. He was arrested in Ramleh, Egypt, and will, no doubt, be brought back to Frankfort-on-the-Main, and made to answer for his crime. But for the telegraph his arrest would have been next to impossible.

Annual Meeting of the Westinghouse Electric and Manufacturing Company.

The annual meeting of the Westinghouse Electric and Manufacturing Company was held May 18, at the company's office on Penn avenue, Pittsburgh. After reciting the facts relating to the reorganization of the company, the president's report says:

The following figures show the indebtedness of the company on January 1, 1891, and March 31, 1892, and the reductions made between those dates in the indebtedness of the company and its leased companies:

	Jan. 1, 1891.	Mar. 31, 1892.	Reduction.
Bills Payable	$3,076,021 11	$461,962 17	$2,614,056 94
Accounts Payable	722,469 51	266,973 19	455,496 32
Sundry Liabilities	344,179 54		344,179 54
U. S. E. L. Co. Bonds	750,000 00	650,000 00	100,000 00
Sawyer-Man E. Co. Mtge.	210,000 00	210,000 00	
Scrip Dividend	195,962 00	194,362 00	1,600 00
	$5,298,632 16	$1,783,297 36	$3,515,334 80
Interest paid January 1, 1891 to March 31, 1892			135,256 65
Total amount paid			$3,650,691 44
By receipts sale of preferred stock applied to above			875,000 00
From earnings and collections			$ 775,691 44



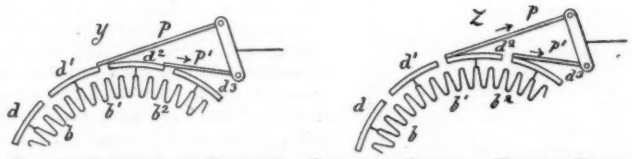


FIG. 4.—SPARKING OF DYNAMOS.—COMPOUND BRUSH IN VARIOUS POSITIONS.

Notwithstanding the serious disadvantages necessarily incident to the reorganization, the company succeeded during this period in keeping its factories in operation and conducting a large business. It has thus been able to maintain its position as a competitor for the electric light and power business of the country, as is shown by the fact that from January 1, 1891, to March 1, 1892, its sales, including those of its leased companies, aggregated $3,468,900.50.

The impetus given to the business by the reorganization is shown by the fact that the orders taken by the company during the two months of March and April of this year aggregate $1,576,235.83, and the prospects for a large business were never better than now.

Previous to 1891 the company's sales were mainly confined to apparatus for incandescent electric lighting by means of the alternating current transformer system. During the latter part of 1890 the manufacture of electric power and street railway apparatus was begun, and during 1891 a large amount of such apparatus was manufactured and sold, all of which has shown satisfactory results in daily use, and has earned such a reputation for design, superior workmanship and efficiency that we are justified in expecting that this branch of our business will assume still larger proportions in the future.

The selling and general expenses have been so reduced that your company is now able to make good apparatus at prices considerably below those prevailing last year, with the result of greatly stimulating the demand for all kinds manufactured by it.

The company's factories have been so rearranged that they can now not only produce a large amount of electric light and power apparatus, but also meet the large and rapidly increasing demand for electric railway apparatus; and further additions to the company's capacity in this branch of its business can be made by the full utilization of the machinery and tools at the factory of the United States Electric Lighting Company at Newark.

The company now employs over 1,600 men, and its factories, which are now capable of caring for monthly sales of over $500,000, can, with a comparatively small expenditure for new tools, be increased to a capacity of over $750,000 per month.

The cash on hand, accounts and bills receivable, manufactured product and material partly manufactured and in the storeroom of your company and its leased companies and other items available as working capital, aggregated on March 31, 1892, $3,322,280.19. In addition to this, the company has in its treasury 7,355 shares of preferred stock, 19,242 shares of assenting stock and $332,751,97 of first mortgage bonds of local light and power companies, upon all of which the company expects to realize as may be required from time to time by the needs of the business. The company is also the owner of a large amount of stocks of local electric light and power companies which are constantly appreciating in value.

The company owns a large number of patents, many of them held by the earliest companies organized in the United States, for manufacturing electric light and power apparatus, and while it is involved in some of the litigation which, unfortunately, seems to be necessarily incidental to the ownership of all valuable patents, it has, nevertheless, such confidence, not only in its patents, but in the superior merit of its apparatus, that your officers feel no apprehension as to the outcome of the suits now pending or which may be brought by our competitors hereafter.

The competition in the electric business, which has heretofore been due to the operation of a number of companies, has materially changed during the past six months. A company has been organized to consolidate the four principal competing companies, and presumably the minor companies controlled by these organizations, so that now your company has but one important competitor.

According to the reports of the various companies, the aggregate value of all the electrical machinery and apparatus turned out during the year 1891 did not exceed $35,000,000. As before stated, the capacity of your factories, by a slight additional outlay, can be increased so as to manufacture fully 40 per cent. of all the electrical light and power apparatus required by the trade.

The usual attempts of competitors to interfere with the trade of your company by the issuance of circulars, and by threatening customers with patent litigation and other annoyances, are having, as a matter of fact, a beneficial effect upon your business in many respects. It seems to be the view of your principal customers that all users of electric light and power apparatus must soon recognize that an independent concern like your company is essential to their prosperity, and that such a concern, conducted on good business principles, should be supported, as a failure to do so might lead to such a monopoly in the electric light and power business that consumers would be forced to purchase apparatus upon any terms that might be dictated.

In conclusion, it is thought that the stockholders of the company are to be congratulated on the marked improvement in its affairs during the past year. While the amount of its capital stock remains as originally created, the result of the reorganization leaves a substantial portion of it in the company's treasury, and two other companies, with aggregate capitals amounting to four millions of dollars, have been practically absorbed. Upwards of three millions of dollars of debts have been paid, and instead of being weighed down by a heavy indebtedness, the company finds itself with improving credit and in a position to compete successfully with any and all rivals. While expenses have been reduced materially, the efficiency of the various departments have been increased. The company is not handicapped by the necessity of earning dividends on an unwieldly capital representing issues of stock based upon imaginary profits. The efforts of the management have been in the direction of conservatism, and this course will be followed in the future so far as may be consistent with pushing the business of the company with the utmost energy. While the stockholders have made some sacrifices, there is every reason to believe that the result will prove that the course adopted was judicious, and that it will bring a fitting reward.

The balance sheet on March 31, 1892, is as follows:

ASSETS.

Cash in banks		$88,045 24
Bills receivable		224,238 72
Accounts receivable		1,247,427 50
Material in stock (at cost of labor and material)		509,543 32
Advances to leased companies		1,045,057 81
Stocks and bonds		4,003,163 09
Real estate and buildings		415,082 77
Machinery and tools		459,968 86
Miscellaneous		63,424 75
Charters, franchises, patents, etc		4,346,717 19
		$12,402,769 75

LIABILITIES.

Accounts payable		$233,956 38
Bills payable		455,462 17
Sundries, contracts and contingent liabilities:		
Scrip dividend, due Sept., 1900		194,362
Stock subscription		35,075
U. S. Electric Lighting Company's six per cent. 15 year bonds, $50,000, payable annually		650,000
Capital stock liabilities:		
Preferred stock, 72,384 shares	$3,619,253	
Assenting stock, 100,758 shares	5,037,616	
Common stock, 5,526 shares	276,300	
In treasury, 21,339 shares		$8,933,469
Surplus		880,445 20
		$12,402,769 75

The new board of directors elected is as follows: Charles Francis Adams, Lemuel Bannister, August Belmont, A. M. Byers, N. W. Bumstead, Marcellus Hartley, Geo. W. Hebard, Henry B. Hyde, Brayton Ives, George Westinghouse, Jr. The only change was the election of Mr. Bumstead in place of Charles Fairchild, resigned.

Detroit Electrical Works.

The Detroit *Evening News*, in a recent trade edition calling attention to the manufacturing industries of Detroit, speaks in part as follows of the Detroit Electrical Works: When the company was first incorporated a small factory was found sufficient for the requirements of the business, but this was soon enlarged until, when the factory was removed to its present location, a building covering ground space 150x120 feet, the greater portion of which is three stories high, was found necessary to meet the requirements of the business. To this is now being added a three story structure, 100x120 feet, which will give this company the largest factory facilities of any electrical institution in Michigan, and one of the largest in the country. The machinery and appliances with which the factory is equipped are of the best and latest design; the arrangement of same and general details of the shop being such as will compare with any factory in the country. The steam engines which furnish the power to operate this factory, instead of being belted to the shafting on the old plan, are belted direct to electric generators, the current from which is distributed through the factory by means of wires and used to operate electric motors, each department being equipped with one of these, so that each is independent and can start or stop its machinery at will, this plan being the most economical for the distribution of a large amount of power throughout a large factory. When the new building is completed there will be in use three engines aggregating 500 horsepower. There are at present 220 hands employed in the factory, and the annual output is valued at $750,000, the apparatus being sold in every section of the country. The number of hands and annual output will probably be trebled when the new portion of the factory is put in operation. The official management is characterized by an enterprising and judicious direction, and the industry justly takes rank among the largest and most important of its character in the world.

ELECTRICAL REVIEW

Published at 13 Park Row,
P. O. Box 3329. NEW YORK.

EDITOR:
CHARLES W. PRICE.
ASSOCIATE EDITORS:
STEPHEN L. COLES.
ROBERT H. READ.

REGISTERED CABLE ADDRESS:
ELECTVIEW," NEW YORK.

"1546 CORTLANDT," TELEPHONE CALL.

BOSTON OFFICE:
W. I. BARKER, Room 29, 620 Atlantic Ave.
WASHINGTON OFFICE:
GEO. C. MAYNARD, 1409 New York Ave.
CHICAGO OFFICE:
MERWIN J. BULKLEY, 435 "The Rookery."
EUROPEAN OFFICE:
JOSEPH FFRENCH, Editor for Europe.
HOTEL VICTORIA,
Northumberland Ave., Charing Cross, London, W. C.

Cable Address: - - "Electview," London.
Telegraphic Address: Ffrench, "Victoriola," London.

ADVERTISING DEPARTMENT,
H. T. RICHARDS, Manager.

PATENT BUREAU,
ROBT. H. READ, Manager.
Patents procured in United States and all foreign countries. Searches, Investigations and Reports on Validity and Infringement.

SUBSCRIPTION TO THE ELECTRICAL REVIEW.

One Year, United States and Canada, - $3.00
One Year, Foreign Countries, - - 5.00
Single Copy, - - - - - - - .10

ANNOUNCEMENT.

Address all communications and make all money orders and checks payable to order of ELECTRICAL REVIEW, P. O. Box 3329, New York.

No attention will be paid to communications for the REVIEW without the *name and address of the writer.*

NEW YORK, MAY 28, 1892.

CONTENTS.

	PAGE.
Views, News and Interviews	177
Thomson-Houston Development	177
Providence Telephone Company	177
New Messenger Call System	177
A Comparison of Modern Methods of Traction	178
An Improved Wightman Motor	178
Sparking and Flashing of Dynamos	179
Protection by Telegraph	181
Annual Meeting of the Westinghouse Electric and Manufacturing Company	181
Detroit Electrical Works	181
Theory and Practice	182
Insanity from Lightning Shocks	182
Farming by Electricity	182
An Unsolved Problem	182
The Passage of Radiation from the Cathode Through Metallic Films	182
Correspondence:	
Our Chicago Letter	183
Our Boston Letter	183
A Visit to Gettysburg	183
The National Class Press Association	183
Personal	183
The Vacuum in Lamp Bulbs	183
Telephonic News	184
Literary	184
An Edison Electric Pump	184
A Magnetic Telegraph Proposed and Described More than 250 Years Ago	184
Industrial Plant of the Chapman Valve Manufacturing Company, Indian Orchard, Mass	184
The Washington Carbon Company	185
Telegraphic	185
Electric Power	186
American Institute of Electrical Engineers	186
One of Faraday's Discoveries Anticipated by Renatus Des Cartes	186
The Ninth Electrocution	186
The Edison Phonograph and the Bettini Micro-Phonograph	186
Another Transcontinental Telegraph Line	186
The American Employers' Liability Insurance Company, of New Jersey	187
Electric Light in Medicine	187
The New England Electric Club	187
Buffalo Electrical Society	187
Denver Electric Society	187
Electric Light News	187
Kindred Interests	188
A Narrow Escape	188
Graphite	188
Electrical Patents	xii

INDEX OF ADVERTISERS.

COVER PAGES.

	PAGE.
American Electrical Works	i
Ansonia Brass & Copper Co	xx
Armington & Sims	xx
Baker & Co	xx
Beacon Vacuum Pump and Electric Co	i
Bridgeport Brass Co	xx
Brush Electric Co	xix
"C. & C." Electric Motor Co	xix
Crocker-Wheeler Motor Co	i
Day's Kerite	ii & xx
Dixon Crucible Co	xx
Eastern Electric Cable Co	xx
Eastwood, Benj	i
Eddy Electric Mfg. Co	i
Hampson & Co., E. P	xx
Jewell Belting Co	xx
Keasbey, Robert A	xx
Moore, Alfred F	xx
Noye Mfg. Co., John T	xx
Okonite Co	i & xx
Perkins Electric Lamp Co	i
Schuyler Electric Co	xix
Simplex Electrical Co	i
Star Electrix Co	i
Van Nuis, C. S	i
Wainwright Mfg. Co	i
Waterhouse Bros	i
Weston Engine Co	i
Wheeler Condenser & Engineering Co	xx
Wilmot & Hobbs Mfg. Co	xx

INSIDE PAGES.

Allis & Co., Edward P	xi
American Bell Telephone Co	xvii
American Casualty Insurance and Security Co	xv
American Engine Co	xii
Arp, A. H	188
Ball Engine Co	xii
Barnes Co., W. F. & John	v
Barrett, John A	xii
Benedict & Burnham Mfg. Co	iii
Bernstein Electric Co	x
Bickford & Francis Belting Co	xi
Bishop Gutta Percha Co	xi
Brill Co., J. G	xvii
Buckeye Engine Co	xiii
Bunnell, J. H. & Co	xii
Burton Electric Co	viii
Central Electric Co	ix
Church & Sleight	xvii
Conover Mfg. Co	viii
Cutter, George	x
Detroit Electrical Works	x
Dwight Slate Machine Co	vii
Edison General Electric Co	vi
Edison Mfg. Co	xiii
Electric Construction and Supply Co	vii
Electric Secret Service Co	xviii
Electro-Light Engraving Co	vii
Elektron Mfg. Co	x
Empire China Works	xvii
Eureka Tempered Copper Co	xi
Evans Friction Cone Co	xii
Faraday Carbon Co	xiii
Falls Rivet & Machine Co	xi
Fitzgerald, S. G	xii
Fletcher & Fletcher Electric Co	xvii
Fort Wayne Electric Co	xviii
Garvin Machine Co	xv
Graves Electrical & Mfg. Co	188
Greeley & Co., The E. S	iv & xv
Heisler Electric Co	ix
Hill Electric Co., W. S	vi
Holmes, Booth & Haydens	xviii
Independent Bung Co	xv
Interior Conduit and Insulation Co	vii
Johns Mfg. Co., H. W	viii
Judicial Sale of Electric Street Railway	188
Ladd, Alfred W	xvii
Law Battery Co	188
Leclanche Battery Co	xi
Leffel & Co., James	viii
Lehigh Valley Creosoting Co	xi
Leonard & Co., H. Ward	xvii
MacKie, Robb	188
Marshall, Wm	xii
McCreary Electrical Specialty Co	v
National Pipe Bending Co	xi
New England Butt Co	v
New York Belting and Packing Co	xvii
New York Insulated Wire Co	v
Onondaga Dynamo Co	vi
Ostrander & Co., W. B	xvii
Penn Life Co	xii
Phœnix Glass Co	viii
Phosphor Bronze Smelting Co	xv
Prentiss Tool & Supply Co	188
Queen & Co	xii
Railway Equipment Co	iv
Rhode Island Tool Co	vi
Ridlon & Co., Frank	xii
Rosenbaum, Wm. A	xii
Royce & Marean	xvii
Roy Valve Co	iii
Sawyer-Man Electric Co	iv
Seely, John A	iii
Shawmut Fuse Wire Co	xi
Shipman Engine Co	xi
Short Electric Railway Co	x
Solar Carbon & Mfg. Co	xv
Somoff, I. L	xv
Standard Electric Time Co	xv
Standard Paint Co	xi
Time Electric Co	xii
Thomson-Houston Electric Co	vii
Tyndall, Wm. D	xii
Waddell-Entz Electric Co	xvii
Walworth Mfg. Co	iii
Washburn & Moen Mfg. Co	xii
Washington Carbon Co	v
Watson & Stillman	xv
Western Electric Co	xv
Westinghouse Electric & Mfg. Co	iv
Willson, H. B	xii
Wood, Jr., John	viii
Woodhouse & Rawson	xv

The Schenectady, N. Y., *Star* refers to electricity as "that scientific maid-of-all-work."

Mr. McBerty's paper on "Sparking of Dynamos," which appears in this issue, deals in an interesting manner with a problem of importance to every dynamo designer.

Mr. Adolph Berrenberg, in a communication on the opposite page, contrasts the use of mercurial and mechanical pumps in exhausting the air from incandescent lamp bulbs. Mr. Berrenberg is strongly in favor of a mechanical pump and gives his reasons therefor.

Assemblyman Sulzer's bill to provide better protection against loss of life by fire in New York city has become a law by Gov. Flower's signature. The act requires that owners of theatres, hotels, halls, schools, hospitals, asylums, factories, lodging-houses and other large buildings shall, under the direction of the Fire and Police Commissioners, provide means for the quick communication of alarms of fire or accident to the Police and Fire Departments, and that each building shall contain hose, extinguishers, buckets, axes, fire-hooks and fire-doors, and other means of preventing and extinguishing fires. And now let the auxiliary fire alarm companies take heed and make large sales.

THEORY AND PRACTICE.

In no art or science are theory and practice so strongly linked together as in electricity. Both the purely theoretical electrician and the distinctly practical electrician have their places—in theory. An electrician pure and simple is impossible without he possesses a combination of theory and practice. The expert courses at several of the large electrical manufactories are designed to take in college men who have a pretty correct idea of the theory of electricity and teach them the practical part. The combination produced is an electrician of more or less ability, varying with the individual. Practice and theory are co-relatives with a mutual dependence and having their common relation in the nature of science as science. Practice never fails to develop theory; theoretical discussions inevitably make practice more perfect. Certain art-practice, it may seem, is wholly unguided by either rule or principle; but in fact this is not so. Every one who practices an art or science even in an unintelligent way, acquires by experience both rules and principles; and these, though he may never formulate them, really control and direct his work.

INSANITY FROM LIGHTNING SHOCK.

It is reported that James Grant, a lineman for the Chicago Telephone Company, was made insane by an electric shock received while talking through a telephone. He is now said to be a raving maniac, and is confined in a hospital. The accident happened during an electric storm and while Grant was telephoning to the central office in regard to some repairs he had made. He was waiting for a reply at the telephone when a bolt of lightning flashed near by and Grant fell unconscious to the floor. While this case presents many curious features, it cannot be used as an argument against the use of the telephone. The man might have been poking a fire or doing anything else and he probably would have been struck by lightning all the same. But the fact of insanity resulting from a lightning shock is one with which we are entirely unfamiliar. If it is true that this man is a raving maniac he represents a unique case for the medical fraternity. It may be discovered that Grant had mental peculiarities which only required such an incentive as a lightning shock to unbalance his mind. While the occurrence is an extremely rare one, it is also very sad, and it is hoped that the unfortunate lineman will speedily regain his health and reason.

FARMING BY ELECTRICITY.

The bill recently introduced in Congress by Senator Peffer, providing for the establishment of an experimental station for the purpose of determining if electricity can be profitably used and applied as a motive power in the propulsion of farming machinery, has received the attention of a large number of humorous newspaper writers. They speak of the golden future when grain will be reaped by the manipulation of a dynamo, and when the pressing of a button will do all the chores. Pictures are drawn of the farmer of the future in a shady spot with a pipe and conducting his harvesting operations by transferring plugs in a switchboard. There may be some humor in the matter, but there is a great deal more of practical common sense. A writer in a recent magazine article declares that the day is not far distant when the entire labor, from the preparing and tilling of the ground to the transportation of the crops to the railway station, will be performed by electric motors. There is no doubt at all as to the ability of electricity to perform all these operations to-day, but many electrical inventors who are working upon this problem realize that the question of economy is a very important one, and until these devices and their applications can be made cheap enough to be practically useful, we will not hear so much about it. It is certainly more sensible on the part of the Government to spend money in electrical experiments, than in an attempt to compel rain from clouds.

AN UNSOLVED PROBLEM.

Under this caption the New York *Evening Sun* thus sensibly treats the subject of execution by electricity:

The execution of Tice by electricity at Auburn seems to have been, comparatively speaking, the most humane one yet perpetrated. The subject was apparently in a state of nervous collapse in which the slightest shock would have been sufficient to kill him.

But Dr. Frederick Remington, of Rochester, one of the physicians who saw the execution and assisted at the autopsy, unconsciously exposes the ignorance of the medical fraternity about the whole subject of executions by electricity. In an interview published in the *Sun* of this morning he complains that Tice did not die in an orthodox manner because none of the "spots of Tardieur" were found on the lining membrane of the dead man's brain. This, no doubt, will be disappointing to other medical experts on premeditated death by electricity.

Moreover, Dr. Remington is frank enough to acknowledge that the original theory of electrical executions has no substantial basis, in Tice's case at any rate. It seems clear to him that the current passed chiefly through the blood channels, and not through the nervous system. Mr. Edison was the first to bring this probable result into prominence, but some medical theorists were bold enough to insinuate that the great electrician did not know what he was talking about.

The weakness of the system is that no medical man can formulate an equivalent to meet each case of individual resistance to the current. It may be, as in Kemmler's case, that the current will take a long time to kill, or, as in Tice's case, that it will take only a short time. But the pressure and quantity of electricity which will kill a man painlessly is as far from being determined as ever. Indeed, the experiments lately made by Tesla show that a rise in the voltage of an alternating current ultimately makes it harmless. It is certain, therefore, that though men can be killed by electricity, we know nothing positively about the manner in which the current causes death.

THE PASSAGE OF RADIATION FROM THE CATHODE THROUGH METALLIC FILMS.

Prof. H. Hertz, in an article in *Wiedmann's Annalen*, states that radiation from the cathode behaves differently from light in its power of passing through solid matter. The thinnest films of the most transparent substances are perfectly opaque to it, as also are thick metal plates; thin metallic films, however, are more transparent to it than to ordinary light. On a piece of phosphorescent uranium glass the author stuck a piece of pure gold leaf, and on the latter a few small pieces of mica. The plate was then placed in a vacuum tube with the covered side facing an aluminum cathode plate, and viewed from the other side. The tube was then slowly exhausted with the current on. While the vacuum was low, the uncovered part of the plate alone phosphoresced, the gold plate casting a shadow on it. As the exhaustion increased, the shadows cast by the leaf on the glass became less marked as the genuine cathode radiation increased, till, when the latter was at its maximum, the shadow nearly vanished. The small pieces of mica, however, cast a sharp black shadow. The same was repeated with various other metallic films with similar results. The gold leaf acting as a mirror to the phosphorescent light, the effect on the eye of any phosphorescence produced behind the leaf is doubled; *e. g.*, if the leaf allows one-third of the radiation to pass, the part behind the leaf will appear, not one, but two-thirds as bright as the rest. If it allows more than half to pass, the covered part will appear *brighter* than the rest; and with a film of deposited silver the author thinks he has obtained this effect to a slight degree. If the rays pass through the pores, and not through the metal itself, they would afterwards be diffused in all directions, like light after passing through opal glass. To test this, a thick aluminum diaphragm was inserted 20 centimeters in front of the cathode, and in the middle of the diaphragm was a hole a few millimeters in diameter covered with a piece of thin aluminum foil. A plate of phosphorescent glass placed close behind the diaphragm showed a bright image of the hole; and as it was withdrawn further and further from it the size of the image of the hole increased in proportion, showing that the radiation through the foil was in straight lines and not diffused.

CORRESPONDENCE.

OUR CHICAGO LETTER.

The Central Electric Company report considerable activity in the sale of Okonite wire, their orders for the current week aggregating 500,000 feet, Manson and Okonite tape being in fair demand as well.

Mr. Jas. H. Mason, who, as general manager of the Simplex Electrical Company, is well known to the electrical fraternity, has been spending the past week among his friends in St. Paul and Chicago.

The Pullman Building, which was originally wired with a mixture of underwriters and other cheap wires, is now being fitted throughout. The steady calls for more light have made this necessary; hence, the electrician, Mr. A. H. Bauer, has planned the wiring anew, using Simplex braided rubber throughout.

Mr. Wm. H. McKinlock, president of the Central Electric Company, has returned from a successful extended Western trip, having called upon many of his old friends and customers of his company and made many new ones. Mr. McKinlock secured an order for the entire underground electrical system of one of the larger Western cities (Okonite wire to be used) besides other valuable trade.

Personal.—J. H. McGraw, of the *Street Railway Journal*, New York, is in this city. D. B. Dean, eastern representative of the McGuire Manufacturing Company, spent Sunday and Monday in the city. Wm. Sutton, president of the American Car Company, St. Louis, Mo., spent Thursday in the city. W. H. Mason, general manager Railway Equipment Company, returned to the city this week after a short business trip to New York. A. W. Dutton, representing the St. Louis Engineering Company, St. Louis, Mo., paid this office a visit while in the city this week. James Partridge, general manager of the Partridge Carbon Company, Sandusky, O., is in the city calling on his many friends. M J. B.

Chicago, May 21.

OUR BOSTON LETTER.

Mr. W. C. Bryant, of Bridgeport, Conn., the well-known electrical manufacturer, was in this city during the week.

Mr. Charles I. Hills, with the Perkins Electric Lamp Company, was among the electrical visitors to the "Hub" recently.

The Robinson Motor and Battery Company has leased a commodious suite of offices on second floor of the John Hancock building, this city.

Electric Railway Progress at Worcester, Mass., continues. Work has begun on the Millbury line and the electric road to Clinton, Mass., has been projected.

Mr. B. E. Davis, representing Messrs. Pass & Seymour, of Syracuse, N. Y., manufacturers of China for electrical and other purposes, was in Boston this week.

The Boston Belting Company, at its director's meeting, held May 5, declared a dividend of five per cent. ($5), payable June 1, to stockholders of record, May 20.

Springfield, Mass., and Indian Orchard, six miles apart, will soon be connected by an electric railway. Several hundred laborers are now at work constructing the road-bed.

New Haven, Conn., is fortunate in being the place selected—it is said—by the New American Arc Light Company, of New York, as a suitable location for the company's factory.

Messrs. Chas. H. Page & Company, electricians and constructing engineers, Worcester, Mass., have accepted an agency for the Eco magneto-electric watchman's clocks and Bradbury-Stone storage batteries.

The West End Railway Company, this city, will soon have another of its branch roads equipped with electricity, *i. e.*, the line running between Charlestown and Bunker Hill district and various points in this city.

Col. Louis W. Burnham, general manager of the Electric Gas Lighting Company, started on a business trip to the Pacific slope Monday, May 9. Col. Burnham expects to return about the middle of June.

The Lynn and Boston Street Railway Company has requested of the Massachusetts railroad commissioners permission to make surface and underground changes—on its line of road—necessary for the adoption of electricity as a motor power.

The Ellis Car Company, at Amesbury, Mass., is entitled to congratulations for the fine street cars it has furnished electric railway people during the past Winter. The company is in receipt of complimentary communications from various sections of the country.

The Fitchburg Steam Engine Company, Fitchburg, Mass., is nicely settled in its new works in the northern suburbs of the city named. With largely increased manufacturing facilities the company will now be enabled to complete and deliver an engine of 150 horse-power per week.

The Orange, Mass., Electric Light Company is reported as having purchased water power privileges at Wendell Depot, a few miles distant, and it is the company's intention to erect a new station at the latter place. The water wheels will be furnished by the Rodney Hunt Machine Company.

The National Pipe Bending Company, of New Haven, manufacturers of the National Feed Water Heater, has closed several large orders recently through its New England office. Among these orders was one for two heaters, aggregating 700 horse power, to be placed in the power house of the Portland, Me., Street Railway Company.

The New England Engineering Company, Waterbury, Conn., has purchased a controlling interest in the street railway of the city named. As soon as permission is granted by the Connecticut Legislature for the company to adopt electric propulsion, the citizens of Waterbury will soon after be furnished with one of the best electric railway systems.

The Campbell Electrical Supply Company, this city, held its annual meeting at Manchester, N. H., recently and elected directors as follows: R. A. Stewart, F. A. Spooner, M. A. Blaisdell, H. F. Campbell, J. A. Jackson and J. A. Emery. These gentlemen will hold a meeting in Boston within a few days and elect officers of the company.

Lynn, Mass.—Advices from the city named, under date of May 16, state: "It is reported here that the contract for the large factories of the new General Electric Company, to be located on the bank of the Saugus river, had been awarded to Boston parties for $275,000. The buildings are to be of brick, of the most substantial construction, and the work is to be pushed as rapidly as possible."

The Whitlock Pipe Coil Company, Elmwood, Conn., recently placed upon the market the American feed water heater, the result of several years experience in the manufacture of a similar line. This heater possesses a number of meritorious features which certainly will make it popular. The Jarvis Engineering Company, this city, has been appointed New England agents, and will be pleased to send particulars.

The Leach & Grant Company, the well-known masons, contractors and builders of this city, are setting two boilers of 150 horse-power each at the central station of the Malden, Mass., Electric Light Company. The boilers will be supplied with "Suffield" grate bars. The same company has received recently a large order from the American Print Works, Fall River, Mass., requiring the setting of six boilers, each of 150 horse-power. W. I. B.

Boston, May, 21.

A Visit to Gettysburg.

Through the courtesy of Hon. John Russell Young, fourth vice-president of the Philadelphia and Reading Railway, about 200 newspaper men of New York and Philadelphia, and their ladies, visited the battlefield of Gettysburg last week. A special train of parlor cars was placed at the disposal of the journalists and they were taken to Gettysburg and back through the beautiful scenery of the Reading system, abundant refreshments being served *en route*. Mr. Ralph Meeker, of New York, Mr. Charles R. Deacon, of Philadelphia, and General Superintendent M. F. Bonzano represented the Railway Company and saw that the comfort of everyone was complete. Lunch was served at beautiful Klapperthal, near Reading.

The battle-ground was visited under particularly favorable auspices. Col. John B. Batchelder, the Government historian of Gettysburg, was present and assisted the guide, Mr. Minnigh, in telling the story of the three days' battle of July 1-3, 1863. It was probably a surprise to nearly everyone to discover that some 400 monuments, representing a cost of hundreds of thousands of dollars, had been erected by the different States in honor of various commanders and regiments, and all had been laid out on a plan that gave a magnificent idea of the lines of battle. Wednesday evening a reception was given by the mayor and other citizens of Gettysburg, and a number of eloquent journalists, including Col. John A. Cockerill, Mr. Murat Halstead, Mr. J. I. C. Clarke, Mr. John W. Bailey, and others, delivered interesting addresses. Col. A. Cowan, who commanded Cowan's battery at Gettysburg, which took a very important part in the fight at the "Bloody Angle," was present and gave an interesting account of the terrible scene, and also made a favorable impression by his defense of the Army of the Potomac, which up to the time of this battle had met with many reverses.

A newspaper called *Our Little Kid* was printed at Harrisburg and edited by several of the journalists who left Gettysburg in advance for that purpose. The paper was quite a hit and contained interesting communications from nearly everyone present, including Messrs. Murat Halstead, John A. Cockerill, C. O'Connor Hennessey, James, Clancy, Chas. W. Price, J. I. C. Clarke, Julian Ralph, W. J. Henderson, Hugh Hastings, S. S. Pratt, J. M. Bailey, the *Danbury News* man, and an advertisement from William Berri, for which he paid in advance, and which received the first editorial notice, as of course is proper in all modern and well regulated newspapers. The typographical errors were particularly delightful—what might have been expected from strange compositors handling the Chinese copy supplied in the rush.

Resolutions of thanks to the Reading Railroad were eagerly signed by everyone, and Mr. John Russell Young may felicitate himself on having done a good thing for his fellow journalists, and also indirectly benefited the entire public, for more accurate writing on the subject of Gettysburg, probably the most critical and most important battle of history, may be expected from this time on.

The National Class Press Association.

An organization of the representatives of the leading class and technical publications of the United States, represented in Chicago, held its first regular meeting Thursday, May 19. As outlined in the constitution, this association is designed to admit as active members the advertising solicitors and reporters of the standard class papers with a view of weeding out the objectionable element engaged in soliciting advertising and to promote the mutual interests of the members of the association. Regular meetings will be held the first Tuesday of each month. The association has already 35 members in good standing, and the list is constantly increasing, and it is expected by the end of another month that the association will have 100 members. At the meeting Thursday the following officers were elected for the ensuing year: President, W. A. Carroll, *Scientific American;* vice-presidents, G. G. McDuff, *Johnston's Directory;* J. F. Connor, *Electricity;* D. H. Ogden, *Western Electrician;* C. P. Day, *Manufacturers' Record;* treasurer, M. J. Bulkley, ELECTRICAL REVIEW; secretary, W. Forman Collins, *Electrical Engineer;* directors, J. P. Tuttle, *Western Brewer;* J. W. Dickerson, *Street Railway Journal;* John C. Burnell, *Brewers' Journal.*

PERSONAL.

Mr. J. P. Barrett has announced his intention of retaining his position as city electrician of Chicago.

Governor Abbett, of New Jersey, has appointed State Treasurer George R. Gray an electrical subway commissioner, *vice* James Smith, Jr., resigned.

Mr. Daniel Hungerford, of Waterbury, Conn., who is known in the Nutmeg State as "Uncle Dan," and is a manufacturer of copper wire for telephone, telegraph and electric railroad use, is a guest at the Hoffman House. He is a stout looking gentleman of about 60 years of age, who would make up as a very good Santa Claus. In talking with me yesterday about wire manufacturing he said: "There has been very little telegraph and telephone extension in the last two or three years, but the big orders that are being given out are for wire for the trolley system of electric street cars. There is no other perfected system by which electricity can be used on street cars, and the heavy orders for this class of wire are causing our factory to run night and day.—"*Ben Abou*" *in New York Press.*

Mr. W. F. D. Crane, who has been widely and favorably known as manager of the railway department of the Engineering Equipment Company, has recently become connected with the H. W. Johns Manufacturing Company, 87 Maiden lane, New York, and will hereafter have charge of the electrical department of that company. Announcement has been made of the consolidation of the moulded mica insulating business of the Gould & Watson Company, of Boston, with the Johns-Pratt Company, of Hartford. The mica trolley line insulating materials have entered into the construction of numerous electric railways since the beginning of the electric railway enterprises, and are so well known as to have become standards of use in overhead construction. The Vulcabeston insulating material, manufactured by the Johns-Pratt Company, is also well known to makers and users of electrical machinery. Mr. Crane will give his special attention to the further development of the already large business of the H. W. Johns Manufacturing Company, selling agents of these materials.

The Vacuum in Lamp Bulbs.

TO THE EDITOR OF ELECTRICAL REVIEW:

One of the most interesting stages in the progress of the manufacture of incandescent lamps is the exhaustion of air from the bulbs by the mechanical air pump. So far all lamp manufacturers have made their lamps with the aid of mercurial pumps. But this is no longer true; the Beacon Vacuum Pump and Electrical Company, of Boston, manufacturing between two and three thousand lamps per day, use the Berrenberg metallic vacuum pump for the exhaustion of their lamps without the aid of mercurial pumps, and their lamps have a far better vacuum than any other lamp that is exhausted by means of a mercurial pump.

In the mercurial pump the mercury is the piston and the glass tube the cylinder. Now, I claim that a metallic piston can be made to fit the walls of a cylinder more closely than mercury will to glass. For instance, you can take a tube 36 or 40 inches in length, fill it with the best distilled mercury, close the tube at one end, then place the tube in a vertical position and connect a good vacuum pump on the opposite side, and you will at once see thousands of little bubbles rising between the mercury and the walls of the tube, growing larger the nearer they come to the top.

This experiment shows how close mercury clings to the walls of glass.

A Torricelli vacuum can only be made by filling the tube with mercury and boiling the mercury in the tube. After boiling the tube is reversed and we have a Torricelli vacuum.

Permit me now to explain to you my experiments on metallic pumps.

In the year of 1885, when I first thought of making a metallic pump to be used for incandescent light, I looked over the whole field to find out what had been done in the line of metallic vacuum pumps, but I found nothing but pumps that would remove 90 to 95 per cent. of the air. All these pumps have a soft piston packing consisting of either leather cups soaked in glycerine or a hemp packing. Something had to be done to get a good piston, and a piston that would run for years without ever renewing the packing rings; something which would reduce expenses and delay in such a pump of fine workmanship. I, therefore, begun work on a metallic piston packing. Two years of experimentation in this line brought forth an air tight piston and cylinder whereby I was enabled to create a vacuum and to hold it for several days without any leakage whatsoever. Thus the problem of inventing a mechanical air pump was solved. The first pump was built which produced a vacuum in 24 lamps in 15 minutes, but the lamps were of short life. At that time the inventor was not familiar with the gaseous filaments, and the lamp makers, or the so-called electricians, were more than pleased with the result, as the metallic vacuum pump for incandescent light had been predicted a failure by all those who had heard of it.

A second pump was built and constructed to be operated with mercury, but owing to the unforeseen action of mercury on metal in a vacuum, this pump did not work. The construction of the pump, however, was satisfactory, the only thing missing was a non-volatile liquid. With the assistance of a chemist this liquid was found and the mechanical air pump became a perfect success on May 9, 1890.

Vacuums created by the Berrenberg pump are better than those made by the best of mercurial pumps. The pump in use by the Beacon Vacuum Pump and Electrical Company can exhaust 600 lamps at one time in less than an hour, while a mercurial pump, of whatever style, cannot make as good a vacuum in five hours on six lamps.

Furthermore, the residuum, or vapor of mercury, in a globe exhausted by a mercury pump is injurious to the filament. It will likewise blacken the interior walls of the globe cutting off a portion of the light. On the other hand, a lamp exhausted with a metallic vacuum pump leaves as a remainder vapor of oil, or hydrocarbon, which will be decomposed by the filament in about 25 hours, and thereafter such lamps have a perfect, or a torricellian vacuum. The result is that the lamp will not blacken because it cannot convey the small particles from the filament to the glass, and consequently it will give the given candle-power throughout the life of the lamp, which is also prolonged.

Glass pumps are limited in size, but mechanical pumps can be built to any size, even for the exhaustion of thousands of lamps at a time from 10 to 15 minutes; at present it takes 20 minutes to get rid of the gases contained in the filament.

To make a filament for a lamp that would not contain gases would be a profitable invention. Truly yours,

ADOLPH BERRENBERG.

Somerville, Mass., May 20.

Telephonic News

*** The President has approved the act authorizing the construction of a telephone line on the coast of Virginia from Cape Charles to Assatigue Island.

*** Business men have organized a telephone company which will connect Redwood Falls, Minn., with North Redwood. Lines will be put in the principal business places. Stock is being rapidly sold.

*** The annual financial statement of the Rocky Mountain Bell Telephone Company states, that the paid up capital stock amounts to $305,000, and places the value of its franchise at $195,000. The company's surplus is $64,904.38, and its reserve fund $36,992.95.

*** The Bell Telephone Company makes the following instrument statement for the month ending April 20 and four months:

Month April 20.	1892.	1891.	Inc.
Shipments.....	8,590	6,413	2,177
Returned.....	4,598	3,278	1,320
Net output.....	3,992	3,135	857
Since Dec. 1.	1891-92.	1890-91.	
Shipments.....	30,488	22,367	8,121
Returned.....	17,604	12,839	4,765
Net output.....	12,884	9,528	3,356
Instruments in use April 20	523,994	490,624	33,370

*** J. H. Mehaffy, local manager of the Delaware and Atlantic Telegraph and Telephone Company, was brought before Judge Wales, in the United States Circuit Court, at Wilmington, Del., on May 12, to answer a charge of contempt of court in not placing a telephone in the office of the Postal Telegraph Company. Two weeks have elapsed since the United States Circuit Court of Appeals settled a litigation that had been pending for years, by a peremptory mandamus directing the telephone company "immediately, upon being paid the fees tendered by others, etc.," to place a telephone in the office of the Postal Telegraph Company in Wilmington. The prompt tender of the fees meeting with no response, the telegraph company applied for an attachment for Manager Mehaffy for contempt in not obeying the mandate of the court. The attachment was at once served, whereupon the local telephone manager, by direction of General Superintendent Westbrook, who had been summoned by telegraph from Philadelphia, purged himself of contempt by paying costs and announcing that arrangements were being made to place the telephone in position in the Postal's office. Manager J. L. Hall of the Western Union Company was subpœnaed as a witness, but at first declined to answer on the ground that he had instructions to do nothing in the matter until he received orders from Western Union headquarters. The Deputy Marshal, however, refused to accept Western Union regulations as paramount to the process of the court and the reluctant manager had to answer the summons.

LITERARY.

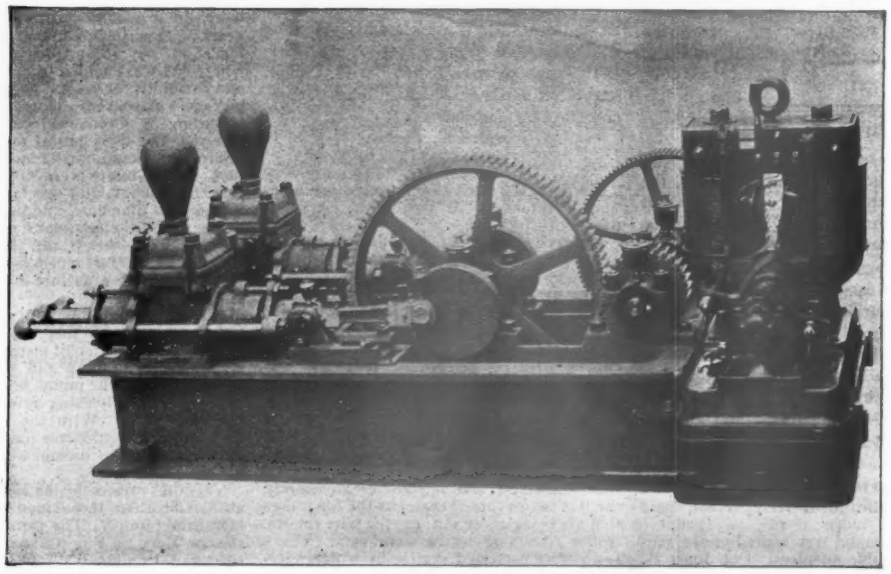
We have received from the Department of the Interior, "Biological Teaching in the Colleges of the United States," by Prof. John P. Campbell, of Johns Hopkins University, and "The History of Higher Education in Ohio," by Prof. George W. Knight, of Ohio State University, and Prof. John R. Commons, of Oberlin College.

The representative character of the *North American Review* is again indicated by the symposium which is announced for publication in the June number. The subject is "The Harrison Administration," and the participants in the discussion are Senator Dawes, of Massachusetts, Senator Dolph, of Oregon and Senator Colquitt, of Georgia.

An advance copy of the second edition of a "Dictionary of Electrical Words, Terms and Phrases," by Prof. Edwin J. Houston, has just been received from the publishers, the W. J. Johnston Co., Limited, *Times* building, New York city. The book bears very little resemblance to the first edition, which was published in 1889, and which is now so familiar to electrical readers. It is practically a new book, as it has been practically rewritten and revised. The book is an octavo and contains 562 double column pages printed on heavy paper. The type used is such that the titles stand out most prominently on the page. The definitions are given in two styles of type, the larger being used for the definitions proper, while the descriptive matter of a more general nature is given a smaller face of type. The illustrations are 570 in number and cover a very wide range of electrical apparatus. Definitions are given under about 5,000 distinct titles, and nearly as many more titles are entered for the sake of giving cross-references to other titles under which their definitions may be found. The book will be ready for distribution within a few days and may be had on application at the office of the ELECTRICAL REVIEW, 13 Park Row, New York. The price is five dollars.

An Edison Electric Pump.

A good combination of a pump operated by an electric motor is the equipment which the Edison General Electric Company are about to put on the market. This consists of an Edison standard motor of the type '85, with a Deane duplex double-acting pressure pump upon one and the same special bed-plate. These pumps have outside packed plungers, with the valves arranged above the cylinders in such a manner that they can be uncovered for examination or repair without removal of any pipes. The covers of the valve chests are held down by swing bolts. To remove these covers it is only necessary to loosen the nuts and swing the bolts away without removing them. The pump is operated by the motor by means of a double gear. The details and arrangement are shown in the cut. The proprietors of the *Daily Palladium*, New Haven, Conn., have, among other improvements made in their plant, discarded their steam engine and adopted electricity as the motive power for their presses. The Edison General Electric Company have installed one of their 12 horse power motors in the *Palladium* building, and the paper observes: "The motor occupies very small space, is noiseless easy to manage, and does its work quite as effectively as the cumbersome and more expensive steam engine, and at far less expense."

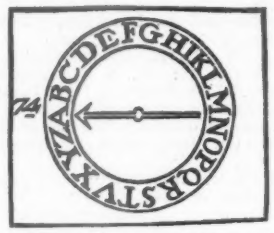


AN EDISON ELECTRIC PUMP.

A Magnetic Telegraph Proposed and Described More Than 250 Years Ago.

A little book printed in Holland, in 1641, left by Dr. Van der Weyde for inspection in the office of the ELECTRICAL REVIEW, is entitled: "Mathematical Entertainments," and according to the custom of that time, mentions its principal contents on the title page. The name of the author is Wynaud von Werten, mathematician and organist.

It has on its 133d page, which we reproduce here, the representation of a compass, with magnetic needle, around which are the letters of the alphabet placed instead of the names of the winds. The writer, after explaining the effect of natural and artificial magnets upon the position of the compass needle, mentions (not as a new idea of his own, but as a suggestion frequently made by others) that by such an arrangement messages could be transmitted, by turning the magnet successively in such positions as to make the compass needle stop, periodically, when pointing at such letters as would spell out the words of the message to be transmitted.



AN EARLY MAGNETIC TELEGRAPH.

There is no doubt that this is perfectly practical for next-door neighbors, but at a distance it would require a very strong magnet. This is what the author considers as the drawback for such a system, and he states that he does not believe that a magnet strong enough to make it practical at a distance could be found or made.

He next expresses his fear that such inter communication at a distance would be very dangerous for the public safety, as it would make all kinds of conspiracies possible, and that it should be forbidden by the government as soon as it was found to be possible.

With our present experience, during the last half century, that inter-communication at great distances, in place of being dangerous, has been very useful and has contributed largely to the public safety, the opinions expressed by our ancestors become now-a-days simply absurd, and we must wonder at their excessive timidity, which crops out at the introduction of every novelty, be it steamboats, railroads, illuminating gas, and last, but not least, electricity as an illuminator, or as a motive power.

*** Martin Griffin, Jr., intends to erect a telephone line from San Mateo to Palatka, Fla., at his own expense.

Industrial Plant of the Chapman Valve Manufacturing Company, Indian Orchard, Mass.

Six miles east of Springfield, Mass., on the Boston & Albany Railroad, is situated the picturesque village of Indian Orchard, familiar to many of our readers for its Indian legends, some of which are historical facts. It will be remembered by many that during the Indian war in Connecticut it was near this village that General Putnam's soldiers hemmed in about 100 Indians, and the latter, to escape, jumped from the cliffs overhanging the Chicopee river, a height of 40 feet, and, with the exception of one, the "redskins" were shot to death or drowned, and the place is known to this day as "Indian Leap."

One mile distant from the railroad station, and near the village, is a cluster of 15 brick buildings which are the works of the Chapman Valve Manufacturing Company. Four of these buildings are three stories in height, and the others, with the exception of four, are two stories, including the company's attractive and commodious office building.

The buildings are constructed of the finest material, with outside finish of pressed brick and marble trimmings; several are fire-proof.

A spur freight track, passing along between the buildings, connects the works with the main line of the Boston & Albany Railroad.

The location of the various buildings is shown in Fig. 1. Nearly in the center of the illustration is the office building, which is connected by an iron bridge with one of the principal work shops, just across the railroad tracks, known as the company's "original building." Its floor dimensions are 100x35 feet. In the front wall is imbeded a marble block bearing the date (1874) the building was erected. The building at the right is the same size in height and length, but 50 feet deeper, and was erected in 1882. Next at the right is a two story machine shop 128x50 feet, built in 1889.

At the left of the work shops—fronting the railroad track—is the most imposing of all the buildings as well as the newest, a machine shop, 140x50 feet, built in 1890. This range of shops may be regarded as the prominent feature of the works, their handsome construction and well kept condition arresting the attention at once. Yet they form but a minor part of the great plant as a whole.

In the rear of the machine shops, toward the left, are shown portions of two roofs, which belong, respectively, to the blacksmith shop, 30x40 feet, at the left, and the power building of the other side of the tall chimney, 35x70. Here are located a battery of boilers and an engine of some 100 horse-power for the operation of the machine shops.

Passing now to the right of the grounds is the test house, 25x30 feet in size, in line with the machine shops, with a couple of sheds in the rear. The twin brass foundries—which form the right of the second row of buildings—are one story in height, and each 50x60 feet in size. These were erected in 1881. Next to the left, and bearing date of 1885, is the pattern storage building, 90x40 feet, and one story in height. Parallel to this is the pattern making shop, also erected in 1885, which is two stories in height. A portion of the upper story is devoted to the use of the draftsmen, as well as to the storage of the drawings. This building was built on fire-proof principles, and is believed to be as safe as can be produced by the best principles of modern construction. In the rear of the pattern making house is power house No. 2, 60x40 feet, containing an improved 50 horse-power Reynolds-Corliss engine and three Whittier boilers. Running from this power house to the rear is a foundry building, 150x30 feet, with an annex, 40x25 feet. These lead to and connect with the main iron foundry, which runs parallel to the machine shops, having a total length of 270 feet, with a width of 60 feet. The main portion of this building, which is two

stories in height, was erected in 1883. Here from eight to ten tons of iron are daily melted for conversion into multitudinous castings which are turned out, of all sizes and of intricate and exacting construction.

The office building—elsewhere mentioned—is 35 feet square and two stories in height. The north end of this building is the private offices of General Manager Jason Giles, and adjoining same is the counting room and stenographers' quarters. Adjoining the counting room and extending southward is the packing and shipping department having 100x35 feet dimension.

The company has now an admirably appointed japanning department where this work is done; and the protective coating which covers the valve gates is as perfect as human skill can devise. Fire hydrants, having direct connection with the Springfield water main, stand in various parts of the ground, with a fire brigade organized among the employés; a series of wells are also being sunk for use in case of breakage in the water main. An electric light plant furnishes the illumination. The Thomson-Houston arc and incandescent systems are used and give thorough satisfaction.

The company has recently patented a brass-seat valve, as shown in Figs. 2 and 3, for use in connection with a high pressure of steam, its peculiarity being a removable bronze seat with extra heavy shells, so constructed as to avoid all tendency to springing, thus overcoming the difficulty incident to expansion and contraction. The seats, which are made from hard gun-metal bronze of steam, are interchangeable and removable. Among other specialties of the company are stem and lever valves for use under a moderate pressure where a quick motion is desired, and which are opened or closed by one movement of a lever, and are readily held in any desired position by a binder wheel; automatic grip valves, heavy pressure valves (for use on pumps), and natural gas valves for light or heavy pressure.

The company are also patentees of the very desirable valve indicator for showing whether valves are open or shut, which can be furnished with new valves when desired, or can be attached to Chapman valves already in use. This is a simple and reliable device, operated by the plug or gate, and hence impossible of disarrangement or of failure in operation.

In addition to the Indian Orchard establishment and the treasurer's office at 72 Kilby street, Boston, the company maintains its own office at 24 West Lake street, Chicago, selling in most other cities through regularly established agencies. In New York, Pancoast & Rogers are the agents; the Pacific coast trade, which is large, is cared for by Holbrook, Stetson & Merrill, of San Francisco. All agencies carry a full line of goods manufactured by the Chapman Valve Manufacturing Company.

This company began active operations on January 25, 1875, occupying two buildings, previously erected by the Indian Orchard Mills Company. One of these was a brick structure, three stories in height, forming a part of the present cluster of machine shops; the other, a one story brick building, 70x40, which has since been taken down, gave accommodation to the foundry department of the business. Some 20 mechanics were at that time employed and the business outlook was such as would have discouraged less determined men than those connected with the enterprise. The financial stress which had begun in 1873, was then at its height, and its effects had been felt far and wide. There were, apparently, plenty of old established houses in the business of manufacturing valves to meet all the demands; it was no light undertaking to win a name and position for a new firm under such circumstances; but it was believed that there was a place for the Chapman valve, and that if made to the standard of its inventors and promotors, it would win its way and find for itself a place.

The result was no disappointment. The business had been launched with a capital stock of $60,000; that was soon found to be inadequate, and the amount was increased to $100,000. But even that did not meet the growth of the business, which required continually increased facilities. Later on the capital was increased to $200,000, then to $400,000, and eventually to $500,000. This handsome capitalization afforded the means for adequately equipping the establishment, providing the buildings and appliances necessary, and putting everything in most perfect condition to meet the requirements of an ever widening custom. In the mean time the number of hands employed gradually advanced to the present total of 250.

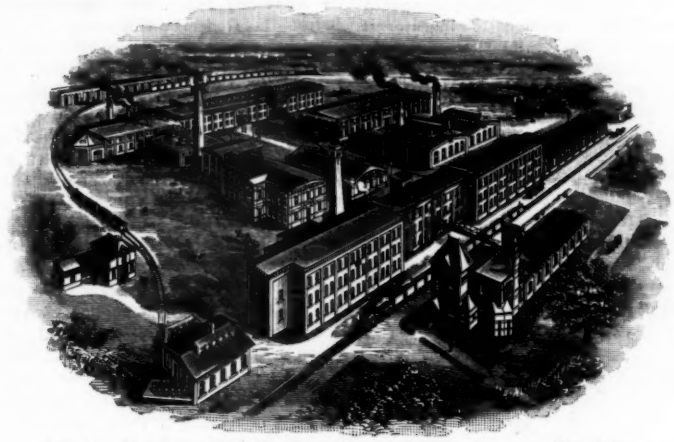
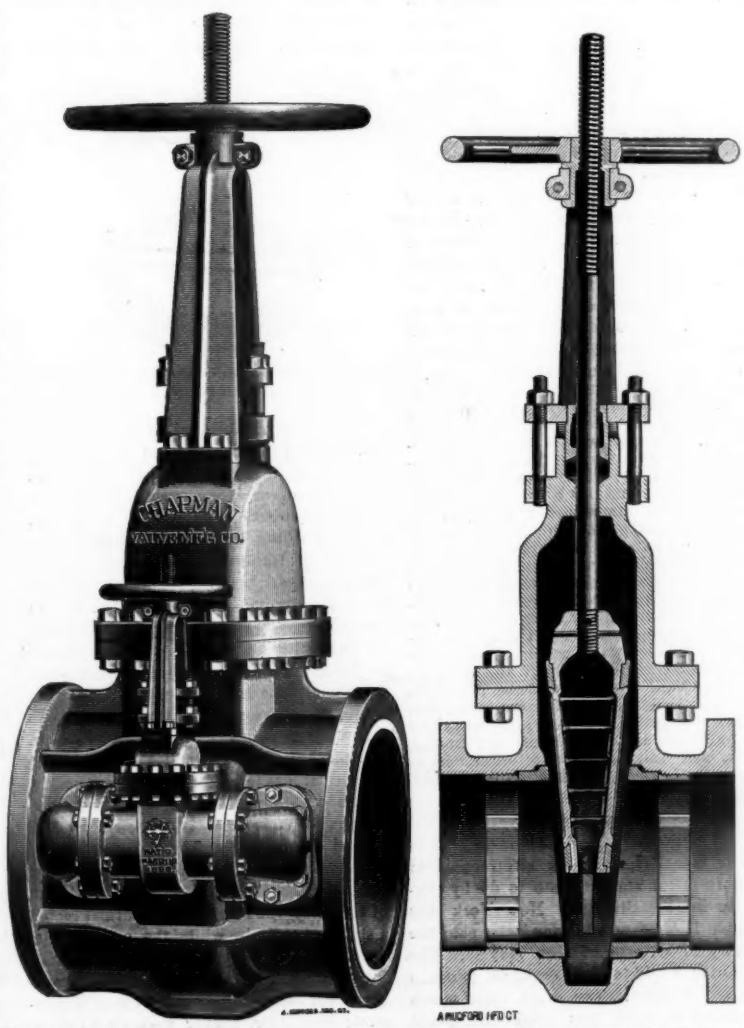


FIG. 1.—PLANT OF THE CHAPMAN VALVE MANUFACTURING COMPANY AT INDIAN ORCHARD, MASS.

The organization of the company must be recognized at once as exceptionally strong. The board of directors consist of Samuel R. Payson, Charles J. Goodwin and Channing Clapp, of Boston, J. W. Smith, of Andover, J. D. Safford, of Springfield, Mass., H. K. Wight and Jason Giles, of Indian Orchard, Mass. Messrs. Payson and Goodwin, are, respectively, president and treasurer of the company, and Mr. Giles is the general manager.



FIGS. 2 AND 3.—NEW VALVE MADE BY THE CHAPMAN VALVE MANUFACTURING COMPANY.

The Washington Carbon Company.

This enterprising carbon company has had to put in a number of new ovens in its factory, at Washington, Pa. The demand for new business has compelled this increase in facilities, as the factory has been compelled for some time to run night and day to fill orders. The excellence of these carbons and their reasonable price, and progressive management have pushed this company to the front ranks of the carbon industry. They have established agencies with responsible houses in all parts of the country, and although crowded by the receipt of numerous new orders, will soon be enabled by their better facilities to greatly increase their output.

.... At the annual meeting of the stockholders of the South Jersey Telegraph Company in Camden, N. J., last week, the following directors were elected: Charles A. Tinker, S. M. Plush, H. Bently, W. T. Westbrook, W. B. Gill, George Merrihew, James Merrihew. The board of directors subsequently organized by the election of the following officers: President, James Merrihew; vice-president, W. B. Gill.

TELEGRAPHIC

... Ocosta, Ore., is the most westerly telegraph office in the United States.

.... The Western Union Telegraph Company has taken charge of the Adirondack and St. Lawrence Telegraph and Telephone Company, now under construction.

.... The plan for putting the Boston fire alarm wires underground has been completed by Inspector B. S. Flanders, and has met with the approval of the fire commissioners.

.... The Buffalo *Express* recently printed an illustrated article describing the police patrol system of that city. Electrician Plumb's electrical kinks and devices received flattering mention.

.... Actors who use the telegraph to effect hasty engagements are numerous, and it is important to them that their messages shall be promptly and correctly transmitted. John Lindsay, who was performing in Salt Lake, sent a telegram to a manager in Helena, offering to play six weeks for $300. The telegram was made to read $200, and Lindsay got a verdict for the difference.

.... The Canadian Pacific telegraph department is experiencing much trouble with its service in Manitoba. It is reported that the entire line from Portage la Prairie to Brandon, a distance of 100 miles, will have to be rebuilt, and in the meantime communication with the coast will be seriously hindered.

.... At the annual meetings of the following companies, held in Philadelphia last week, officers were elected as follows: Continental Telegraph Company—President, James Merrihew; directors, Charles A. Tinker, R. H. Rochester, W. B. Gill, Henry Bently. Delaware River Telegraph Company—President, Charles A. Tinker; directors, W. B. Gill, John Van Horn, Charles A. Tinker, R. H. Rochester, James Merrihew, Henry Bentley. Pacific and Atlantic Telegraph Company—President, Norvin Green; directors, Thomas T. Eckert, W. B. Gill, James Merrihew, Roswell H. Rochester, Charles A. Tinker, Henry Bently. Philadelphia Local Telegraph Company—Henry Bently, president; W. B. Gill, vice-president and general manager; W. P. Wheatland, secretary and treasurer; directors, Henry Bently, James Merrihew, C. A. Tinker, John Van Horn, W. B. Gill.

.... The cable that is to be laid between Senegal and Pernambuco has been shipped from England, and is now on its way to the African coast in the British steamship "Silvertown." It was constructed by the Telegraph Works Company, of London, and a number of recent inventions have been used in its construction. The cable to run between Senegal in Africa and Pernambuco in Brazil was taken aboard coiled up in three tanks and ready for paying out at the bow end of the vessel, not at the stern, as was formerly the custom. The cable is of varying thicknesses, ranging from two and one-quarter tons per knot to four and one-half tons, according to the depth of the water in which it is to be laid, while the shore ends weigh about 15 tons per knot. At Senegal the shore end is to be covered by a hut and left in charge of an electrical engineer, who will be in communication day and night with the cable bearing ship. Signals will be exchanged every five minutes during the whole operation of laying the cable to Brazil. In the deep sea the cable will be paid out at the rapid rate of 10 knots an hour, though large allowance must be made for stoppages through impediments 1,000 fathoms deep. According to the engineer in charge, the line will be laid and the "Silvertown" back in England before the end of the month of July. Aboard the steamer there is a large staff of engineers and assistants, who work in four hour shifts and then have eight hours off. The strain upon them while on duty is very severe. The cable is 2,165 miles long.

* * Binghamton, N. Y., is to have a new electric railroad.

* * The Philadelphia Select Council has passed the trolley ordinance by a vote of 21 to 10.

* * The New Haven, Conn., *Daily Palladium* has recently started a new Cox duplex press. It is driven by a 13 horse-power Edison motor.

* * The electric line between Belleville and East St. Louis, Ill., will be in operation by Fall, and a new public road on the line of the electric road is already projected by the citizens of East St. Louis.

* * The Negaunee and Ishpeming Street Railway Company and Negaunee and Ishpeming Electric Light Company, Negaunee, Mich., have consolidated under the name of Negaunee and Ishpeming Street Railway and Electric Company.

* * The Kansas City and Independence, Mo., Rapid Transit Company proposes to change its motive power from steam to electricity and an estimate of the cost is now being made by B. F. Sunny, of Chicago, of the Thomson-Houston Electric Company.

* * The Oldtown, Me., Electric Railroad Company and the Oldtown and Orono Electric Railway Company have consolidated. It is decided to build the road from the terminus of the Bangor Street Railway on State street to Oldtown. Freight and passengers will both be carried on this line.

* * The Cataract Construction Company ordered by cable last week from Faisch & Picard, of Geneva, Switzerland, plans for two 5,000 horse-power turbine water wheels. The wheels will be built in this country from the plans of the Swiss firm. They are for the central power house at Niagara Falls, and it is said will be the largest thus far constructed.

* * It is proposed to build an electric railway from Harrisburg to Mechanicsburg, Pa. A subscription list was started recently, and over $25,000 of the proposed capital of $100,000 have been subscribed. The line will be eight miles long, touching Bridgeport, Camp Hill and Shiremanstown. A branch line to New Cumberland will probably be an outcome of the venture.

* * The plans for the electric power station at Jersey City for the Jersey City and Bergen Railroad Company were completed last week. They show two large brick buildings, one for the engines and generators, the other for the boiler house. The plot of ground secured as a site embraces eight acres. The buildings will occupy a space 105x160 feet. The engine house will be 65 feet front and 160 feet deep. It will be one story high, with heavy brick walls and iron trusses and roof.

American Institute of Electrical Engineers.

The annual meeting and election of the American Institute of Electrical Engineers was held at its headquarters, No. 12 West Thirty-first street, on Tuesday, May 17. The report of Council showed the membership to be 615, a net increase of 74 over last year. The following officers were elected: President, Frank J. Sprague; vice-presidents, A. E. Kennelly, Nikola Tesla, Oscar T. Crosby; managers, Charles Wirt, Angus S. Hibbard, Dr. Michael I. Pupin, Charles P. Steinmetz; treasurer, Geo. M. Phelps; secretary, Ralph W. Pope. The officers holding over from last year are as follows: Vice-Presidents, T. D. Lockwood, Carl Hering, Wm. J. Hammer; managers, J. C. Chamberlain, P. B. Delany, H. A. Foster, H. Ward Leonard, Dr. Louis Bell, Herbert Laws Webb, Prof. A. G. Compton and James Hamblet. The general meeting of the Institute will be held at Chicago, June 6, 7 and 8.

One of Faraday's Discoveries Anticipated by Renatus Des Cartes.

BY P. H. VAN DER WEYDE.

Those not acquainted with the slow and gradual progress of science in times gone by are very apt to over-estimate the labor of the present generation, and even more, that which was done in the beginning of our century. For instance, Faraday is usually mentioned by lecturers as the inventor of the method for making the spectrum of the lines of magnetic force visible by sifting iron filings over a piece of glass or cardboard under which a natural or artificial magnet is placed. We will, by the adjoined reproductions of the old wood-cuts found in the "Philosophy of Renatus Des Cartes," published in Amsterdam in 1690, prove that this method, as well as the theory which it explains and the cognate properties of magnets, either natural or artificial, and of the earth considered as a huge magnet, was already conceived by that philosopher,

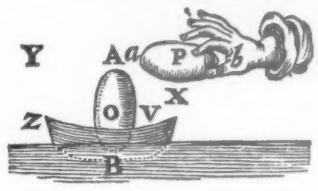


FIG. 1.—SHOWING ATTRACTION AND REPULSION OF MAGNETS.—WOOD-CUT OF 1690.

who wrote the book originally in Latin in 1649. It was translated first into French and then into Dutch. The latter edition, before us, consists of three large quarto volumes, bound into one, and containing, respectively, 424, 118 and 84 pages—altogether 626 pages. The letter-press is, of course, in old style type, and is far better than the wood cuts, as shown by their reproduction here; while, however, the art of copper-plate engraving is superior, as seen by the portrait of that great philosopher, which we also reproduce.

Fig. 1 is a reproduction of Des Cartes' figure showing the experiment to prove the attraction of dissimilar and the repulsion of similar magnetic poles. Fig. 2 shows that the two parts of a magnet will repel one another when divided parallel to its magnetic axis. Fig. 3 shows that two parts of a magnet will attract one another when divided at right angles to its magnetic axis. Fig. 4 shows the Faraday lines of force produced by sifting iron filings over two magnets placed with opposite poles turned to one another. Des Cartes calls them *lines of attraction*, and says that the filings become arranged in an order which shows sufficiently that there is around this body a kind of vortex or rather an atmosphere of a very subtle matter *because it passes* through the pores of the glass; it extends from one pole of the magnet to the other, and arranges itself so as to form arcs of circles which appear to proceed from one pole A to enter again into the magnet through the other pole B. Fig. 5 is a reproduction of Des Cartes' illustrations of the earth's magnetism, showing the increased inclination or dip of the compass needle at high latitudes, and also illustrates the hypothesis that the theory of magnetic and electric action involves rotary motion of the molecules and of the ether surrounding them, and this in opposite directions as shown by the right hand and left hand windings of the seven lines on the particles.

The Ninth Electrocution.

The second man to be electrocuted at Auburn prison and the ninth to die by electricity in the State of New York was Joseph L. Tice, an old man, who paid the penalty of wife murder on May 18. The execution is said to have occupied two and one-half minutes. The death chair which Kemmler occupied was used with slight modifications. Four times was the current sent through the victim. A voltage of 1,720 was used. Just before the current was turned on Tice had closed his left hand. As the current struck him he was closing the right. The movement stopped instantly and the fingers remained in a natural position. The intervals between the shocks were brief. Tice was 63 years old.

The Edison Phonograph and the Bettini Micro-Phonograph.

THE PRINCIPLES UNDERLYING THEM AND THE FULFILLMENT OF THEIR EXPECTATIONS.

Under this title Dr. J. Mount Bleyer, of New York city, surgeon to the New York Nose and Throat Infirmary, recently read an interesting paper, with demonstrations, before the students of Bellevue Hospital Medical College, as the last of a series of clinical lectures on diseases of children. The following is a brief abstract of Dr. Bleyer's remarks:

The value of these two machines at the present time cannot be over-estimated, and while some of Dr. Bleyer's present crude methods of taking and reproducing records or phonograms are not as yet thoroughly practicable, those which were demonstrated must at once lead thoughtful students to think of the further prospects of the growth and development in the application of the phonograph and the micro phonograph. The use of these two machines in physiological researches is a thoroughly scientific matter. Dr. Bleyer then devoted some time to explaining the making of voice pictures, mentioning the work of Mr. Robert Rogers and Dr. Hall in this direction.

As a special department of medicine, which involves the throat, nose and chest diseases, Dr. Bleyer said he owed much to the aid already received from the phonograph and micro-phonograph. Dr. Bleyer's practice had brought him into contact with celebrated people and artists of high vocal culture. With their already fully trained voices he began to make some investigations regarding the adoption of a standard of singing, speaking, etc., by which he could judge the voices of those whose training was not yet up to the standard. The artists whose records he

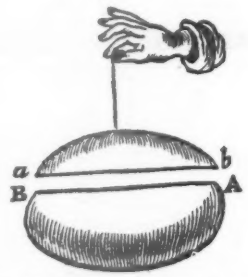


FIG. 2.—REPULSION OF THE TWO HORIZONTAL PORTIONS OF A MAGNET.

took had been educated in the German, Italian and French schools of singing. By repeating to himself over and over again such phonograms, one must become, from such comparisons, a good critic in the art. It is astonishing to hear the methods that the special training of one of these schools gives to singers, and the same is true of actors, elocutionists and others. Dr. Bleyer thought that by further experimental study on this subject he would certainly be able to bring forward a standard as well as an additional new art to aid in the learning of singing, speaking, elocution, acting and many other points connected with them. Dr. Bleyer said that these instruments were of special use to him in phonograming the voices of actors, lawyers, clergymen and singers when in what is technically called "good condition." These records were preserved for comparison in case any one of the patients should be taken with an ailment of the voice, thus making the normal record a standard to go by while the case was under treatment and recovery. He also found them valuable for taking clinical phonograms for further study as well as to demonstrate from. Dr. Bleyer makes it a rule to always take the record of any case that comes to him for medical relief, so that he may be able to judge of the progress of the gradual recovery in such a voice while under treatment. Dr. Bleyer had recently brought before the New York Medical Association a project for taking and preserving records of specimen voices, which records would demonstrate a certain characteristic cough or sneeze, such, for instance, as the whoop of whooping cough, asthmatic breathing in all its forms, stenosis of the larynx, due to whatever cause, and which is so evident in cases of cramp and diptheria, cries of babies at different periods of their growth, stuttering and imperfect speech. To these last two much aid is obtained from the use of these machines as a tutor for correcting the habit. He also proposes to take the phonograms of sneezing and normal breathing, as contrasted with abnormal breathing, etc. These cylinders or phonograms Dr. Bleyer has and proposes to utilize as demonstrative evidence and illustration in the lecture room to be added to the didactic and clinical methods of teaching.

Mr. Edison has been interested in Dr. Bleyer's behalf regarding these studies, and is building a special phonograph for him which will have many new attachments, besides some fine diaphragms on a new principle. With the aid of this new machine Dr. Bleyer expects to be able to receive on its recorder the finest tones and reproduce them.

Among the latest uses of the phonograph and micro-phonograph is one suggested by the daughter of Rabbi Braun, of Cleveland, in which the phonograph and the micro-phonograph may be used to teach the blind to read. This Mr. Edison intends to utilize, and is now working out a method by which to reduce the size of the cylinder and yet increase its capacity. The recording needle is being reduced to half the size of the present one and the screw is made smaller so as to increase the revolutions of the cylinder. The number of words can thus be increased with some extra alterations, say from 2,000 to 5,000 words, and the durability of these cylinders will be such as to be able to repeat the records 3,000 times.

Dr. H. F. Geary, of Baltimore, has adapted the phonograph to the cure of deafness. He speaks of his success as being simply phenomenal, and, considering the simplicity of the principle, he is surprised that this adaptation of the phonograph was not earlier brought to light.

Another Transcontinental Telegraph Line.

Mr. C. W. Bradley, of New York, assistant general manager of the Postal Telegraph Cable Company, with his wife and son, passed through Winnipeg, Man., recently, *en route* East. They have been on an extended tour of the whole western country with a view of increasing the efficiency of the telegraph service of the company. The Postal Company have decided to build a splendidly equipped line over the Sante Fe route, which will, when completed, connect New York with San Francisco over American territory. This will give them and the Central Pacific Railroad an alternative route.

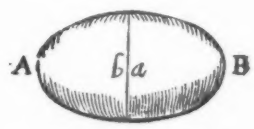


FIG. 3.—ATTRACTION OF THE TWO VERTICAL PORTIONS OF A MAGNET.

It had not been the intention of the company to begin its operations in this direction until 1893, but the late disastrous interruptions of the Central Pacific Railroad lines have shown them the necessity of getting down to work at once. The contracts will be signed as soon as Mr. Bradley reaches New York. The wires to be used on the work will all be of copper, and the best made. The company are now engaged in stringing 10,000 miles of copper wire throughout the eastern States this season. During his short stay in Victoria, Mr. Bradley enquired into the telegraph facilities, with a view of improving them. The result of his investigations will probably be that the company will decide to lay a three-conductor cable to the American side or to Vancouver, which would prove ample for years to come.

The American Employers' Liability Insurance Company, of New Jersey.

The above named company insures manufacturers, corporations and all employers of labor against any liability they may incur to employés for injuries received in the course of their employment. Its policies indemnify employers against all loss, claims and suits on account of accidents to employés under any circumstances whatever.

Similar protection may be had as against accidents to the public in cases where the business involves risk of injury to persons other than employés. This would apply especially to street railway companies, electric light corporations, builders and con-

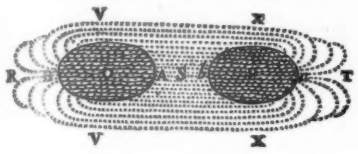


FIG. 4.—DES CARTES' "LINES OF ATTRACTION," SIMILAR TO FARADAY'S LINES OF FORCE.

tractors. In addition to the direct liability for damage claims, employers are frequently subjected to the expense and annoyance of procuring evidence and defending suits where no liability for the accident exists.

Under the provisions of the American's policies, if suit is instituted against the assured, the company, at its own expense, will assume the defence of the action and pay the judgment, if any, besides. The expenses of immediate medical and surgical relief are, in all cases, defrayed by the company, whether the employer is liable for the accident or not.

To be uninsured is to run an indefinite risk which may prove very costly.

Though an employer may surround his business with all reasonable safeguards, he cannot prevent occasional acts of negligence or carelessness on the part of those whom he employs, and such negligence often results in injury to others, and thus entails loss or expensive litigation. Corporation managers and business men will at once see the positive need of an insurance of this character, which gives them absolute protection. The American Employers' Liability Insurance Company stands in the front rank of all companies transacting this particular line of business.

The directors of the company are nearly all large employers of labor, and are gentlemen of high standing in the business and financial world.

Its officers are men of unusual ability and energy, and the extraordinary success obtained by the American is due to administrative ability of a high order.

The manner in which the American has looked after its claims has met with the universal approbation of those who have been so fortunate as to have their interests placed in the hands of this company. From the large number of unsolicited letters that the company has received bearing on this particular and important point, it is with pleasure that we place before our readers the following:

BOSTON, Oct. 27, 1891.

CHAS. W. HOLDEN, ESQ., Resident Manager, American Employers' Liability Insurance Company, No. 30 Congress street, Boston, Mass.

DEAR SIR—It gives me pleasure to say that the experience of this company in the settlement of accident cases by your company has thus far been most satisfactory. The personal interest taken by it through its agents as soon as such cases are reported, and its business methods in adjusting all accident claims are thoroughly commendable, and in striking contrast to our past experience with this kind of insurance.

I take pleasure in recommending all desiring insurance to correspond with your company. I am, very truly yours,

F. A. GILBERT, President and Manager,
Boston Electric Light Company.

The American also writes a driver's risk policy, securing indemnity for personal injury caused by horses or vehicles. Also an elevator policy in which the owner or lessee of an elevator can be insured against liability for personal injury to the public which may occur in the elevator or on the elevator ways. Owners and tenants of buildings can purchase at a moderate cost a general liability policy, protecting them against any claim arising from injury to any one in and around the premises for which they are liable.

Electric Light in Medicine.

There recently died at Vienna, says our London namesake, the mechanician, Josef Leiter, a man who, in concert with eminent physicians, spent many years of his life in zealous study and experiment in order to realize one of the most modern and remarkable ideas of medical science. He was engaged with the solution of the question how far the interior of the human body can be made accessible to the eye of the physician. Before his death he had the satisfaction of knowing that his merits were fully acknowledged in a recent work by the distinguished neurologist, Professor Lewandowski.

The medical world is already able to illuminate the interior of the mouth, the pharynx, the stomach, eye and ear, with the electric light. This is effected either by the direct introduction of the source of light into the organs concerned, or by the reflection of the light. At first the light of incandesced platinum wire was used, but latterly the well-known carbon filaments of the glow-light have been universally employed. The "mignon" glow-lamps, scarcely larger than an ordinary pea, were first shown at the Vienna Electrical Exhibition, and were successfully adapted to this use by Leiter. A number of apparatus for both methods of introducing the electric light (direct and by reflection) have been devised. The instruments for the use of reflected light do not differ in principle from those used for solar light. The electric light has, however, the advantage that the

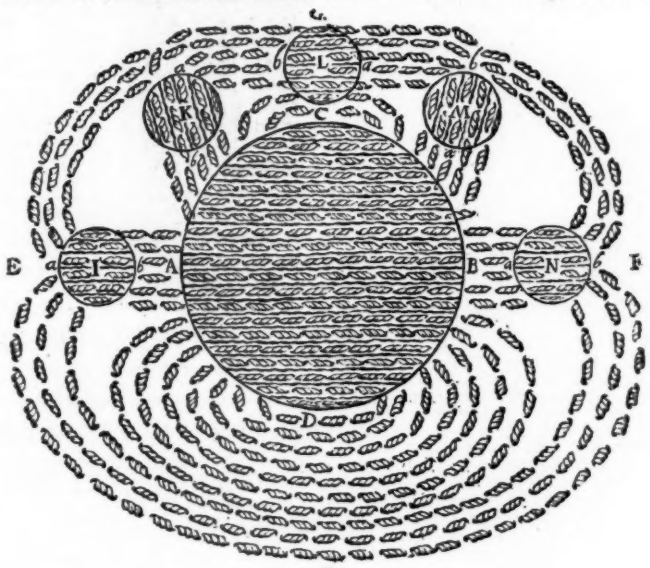


FIG. 5.—DES CARTES' ILLUSTRATION OF THE EARTH'S MAGNETISM.

FIG. 6.—REPRODUCTION OF AN OLD COPPERPLATE PORTRAIT OF RENATUS DES CARTES, FOUNDER OF THE CARTESIAN PHILOSOPHY.

medical expert is rendered independent of the freaks of the weather. This principle can, of course, be combined in all possible manners with concentrating lenses, reflectors, etc. The first such apparatus of this kind emanated from Vienna, where they were executed in 1883 by the optician Jirasko, at the instigation of Prof. Mosett von Moorhof.

In the direct introduction of light we distinguish two modifications, illumination, properly so-called, and diaphonoscopy. This latter method depends on the fact that human flesh is, in thin layers, translucent. If we hold up the open hand with the fingers close together before a brilliant light (not otherwise visible to the observer), the fingers appear at their margins translucent, and transmit a reddish light. This method is used in dentistry. The patient bites a small gag of vulcanite, the lateral process of which, projecting into the mouth, supports a mignon lamp. The interior of the mouth is brilliantly illuminated, and the dentist can look into the inside of the tooth and detect any morbid changes in the enamel, the dentine, the roots, the gums, etc.

The most interesting method at present is that by which the light is directly introduced into the cavities and passages of the body. In examinations of the pharynx a mignon lamp is placed in the shaft of the mirror and the rays are allowed to fall into the pharynx, which is thus brilliantly illuminated and reflected to the eye of the observer. Much more complicated is the introduction of light into the stomach, which is first evacuated by means of the stomach pump and afterwards expanded with air after the apparatus has been introduced. This apparatus is a long tube which has at its closed lower end a glass window, behind which is placed a mignon lamp connected with the battery by wires. When the current is turned on the filament becomes ignited, and illuminates through the window the interior of the body, which a small mirror makes the illuminated parts visible to the observer.

Very favorable reports on the results of such investigations have already been furnished by Professors Oser and Mikulicz.

It will be perceived that the electric light plays already a not unimportant part in the art of healing, although we see only the beginning of its career.

The New England Electric Club.

The New England Electric Club will have its opening at Boston, Wednesday evening of this week. The Club starts with very flattering prospects and a membership of over 200.

Buffalo Electrical Society.

The society held its last meeting of the season May 16. Mr. Frank Kitton, of the Western Union Telegraph Company, read an interesting paper on "Ammeters and Voltmeters and Their Uses."

Denver Electric Society.

The society has arranged a course of 12 lectures on the practical applications of electricity. The officers of the society are: President, E. W. Olds; vice-president, J. L. Stanley; secretary, W. H. McAloney, and treasurer, John Crosby.

ELECTRIC LIGHT NEWS

—— The electric light plant at Red Cloud, Neb., is to be sold by order of the court.

—— The Lebanon, N. H., Electric Light and Power Company will double the capacity of its plant about August 1.

—— An effort is being made to induce the city officials of Seward, Neb., to buy the electric light plant for the municipality.

—— The Louisiana Electric Light Company has secured a ten years' street lighting contract from the city of New Orleans, at a yearly price of $165,000.

—— The stockholders of the Chicago Edison Electric Light Company met last week and decided to increase the capital stock from $1,000,000 to $3,000,000.

—— The Thomson-Houston Electric Light Company, of Orange, Mass., have accomplished the purpose they have had in view for some time, and purchased the water power at Wendell Depot with the intention of removing the Orange electric light plant thither and running by water power hereafter instead of steam.

—— A steam pipe connected with the engine in the Detroit, Mich., Electric Light and Power Company's plant exploded at 8.30 o'clock in the evening of May 17, and simultaneously every street light in the city, as well as many in private houses and other buildings, was extinguished. The streets were in darkness for several hours. No one was hurt.

—— The suit of the Edison Electric Light Company against Westinghouse, Church, Kerr & Company, for infringement of patents for distributing electricity, was finished at Trenton, N. J., May 16, by counsel in the United States Circuit Court before Judge Green. It is not likely that Judge Green will give his opinion before next September. The case will, in any event, be appealed.

—— The Jews are still puzzling over the electric light. Having discreetly dropped the question whether or not it might be used on the Sabbath in face of the prohibition "thou shalt kindle no fire upon the Sabbath day," which effectually barred all other methods of illumination at one sweep, they are now doubting in the pages of the *Jewish Chronicle* whether it ought to be allowed to supersede gas in the synagogues.—*London Lightning.*

—— The Thomson-Houston Company is now making one of the largest switchboards ever built. It is of marble and is for the station of the Narragansett Electric Light Company, of Providence, R. I. It is 18 feet long and 10 feet high. It has plugs for 40 arc circuits, and is made up of 3,500 pounds of marble, 1,793 pounds of brass, 6,400 brass bushings, 9,300 brass nuts, 1,995 steel bolts, 6,040 brass washers, 3,040 rubber bushings, 3,200 rubber buttons, 2,000 brass screws, 3,400 brass connections, 320 brass binding posts, 640 feet of copper wire, 80 contact plugs, eight cast iron standards. It will be completed within a month.

—— The Media, Pa., Electric Light, Heat and Power Company has increased its capital stock from $40,000 to $100,000. The company is in a very flourishing condition and has just commenced the erection of a large building, 55x45, entirely of stone, with iron roof and iron girder floors. It will be supplied with a complete electric light outfit, including four 750 light dynamos, two 150 horse-power engines, a 100 horse power boiler and a 600 horse-power water heating boiler. The company has now a capacity of 5,550 lights, run to their full amount, and is lighting all the passenger stations between Media and Swarthmore, and will no doubt in the near future extend its lines in other directions.

KINDRED INTERESTS

The Central Electric Company, Chicago, report a very active business in the Interior Conduit and Insulation Company's specialities, a great many of the large buildings being equipped with this conduit in Chicago.

The Lunkenheimer Brass Manufacturing Company, Cincinnati, has sent out a very handsome illustrated catalogue of their well known brass and iron goods and specialties for steam, water, gas, oils, etc. It is bound in flexible cloth and may be conveniently carried in the pocket.

Removal.—Owing to lack of room in their present quarters, Kohler Brothers, 341 The Rookery, Chicago, western branch of the Eddy Electric Manufacturing Company, electric motors and generators, have removed to the elegant suite of offices, 1417-1418 Monadnock building, corner Jackson and Dearborn streets, directly opposite United States Post Office.

Mr. Charles E. Sharp has been appointed manager of the Southern Electrical Supply Company. Mr. Sharp is a conscientious, pains taking business man, and since his appointment, May 1, has gotten back a good many of the old customers of the Southern, besides a good many new ones. Mr. William H. McKinlock, the founder and president of the Southern Electrical Supply Company, has just returned from St. Louis, and reports the Southern as doing a very brisk business, and says that under the new management, the prospects for enlarged future trade are very encouraging.

Detroit Electrical Works.—Owing to the great press of eastern business this company has found it necessary to open a New York office, which has been located in the Metropolitan Telephone and Telegraph building, 18 Cortlandt street. This office will be in charge of Mr. T. W. Warfield, as district manager. The company has also opened an office in Boston, in No. 23 Fiske building. The Detroit Electrical Works write as follows: "We find the eastern demand for goods of our manufacture to be very great, and for the convenience of the eastern trade we have made provision, as above, that information respecting our apparatus may be obtained on short notice. The opening of these eastern offices, when taken in connection with the large extensions we are making to our factory, will enable us to handle a large business in a manner that cannot fail to be satisfactory to our patrons."

The Campbell & Zell Company, Baltimore, write as follows: "We are glad to inform you that, notwithstanding the recent extensive additions to our works, which more than doubles our capacity, we are crowded with orders for Zell improved water tube safety boilers, and have recently closed contracts for the following plants: The Central Railway Company, Baltimore, Md., 675 horse-power; the Baltimore City Passenger Railway Company, Baltimore, Md., 1,800 horse-power; the South Park Electric Light Company, Chicago, Ill., 450 horse-power; the Michigan Brass and Iron Works, Detroit, Mich., 150 horse-power, besides a number of smaller boilers, including two 40 horse-power boilers for Otto Sutro & Company and one 25 horse-power boiler for The Thomas Wilson Sanitarium for Children, both of Baltimore. In addition to this, we have also contracted with the World's Columbian Exposition, at Chicago, for 2,500 horse-power Zell boilers for supplying power at the Fair."

It is Seldom Our Good Fortune to receive such an artistic announcement as was received in a recent mail. We were favored by a souvenir in gold, delicately tinted, bearing the imprint of the Providence and Stonington Steamship Company. The company's steamers, "Maine," "New Hampshire," "Rhode Island," "Massachusetts" and "Connecticut" are handsomely illustrated on the front pages. This announcement contains full description and information relative to travel between New York and Boston over the company's lines, as well as beautifully executed cuts of interior views of their several steamers. We do not know whether the company intends to give this souvenir away on application. If they do we can safely say that the supply will not be equal to the demand. The "Maine" and "New Hampshire," which were recently put in service, are steamers well worth inspecting, and a trip to Boston on them is a decided treat. This beautiful souvenir is entirely in keeping with the present passenger service of this company.

A Narrow Escape.

The plant of the Citizens' Electric Illuminating Company, in De Kalb avenue, Navy street and Hudson avenue, Brooklyn, narrowly escaped being burned down last week. About 9.30 o'clock in the evening of May 16, a sheet of flame suddenly illuminated the two-story frame building recently erected as an extension to the Navy street wing of the works. Underneath this extension is a boiler room, and the furnace fires and boilers were in full operation.

Simultaneous with the breaking out of the fire, there was a sudden extinguishing of the electric lights supplied by this company in a large part of the western district.

The electrical eclipse lasted only about 20 minutes. Chief Engineer Nevins was one of the first men to enter the burning frame structure, and he directed the work of cutting off the fire from the main building. Within 15 minutes the fire was under control. The loss will not exceed $5,000.

Graphite.

The Joseph Dixon Crucible Company, Jersey City, N. J., has recently issued an interesting catalogue of its graphite products. We extract the following information about graphite from this pamphlet:

"We occasionally hear of some one complaining of graphite or graphite productions. Now and then such a person, without further investigation, will write to some mechanical paper condemning the use of graphite in places where, *if the graphite is pure and properly prepared*, it should be of the greatest benefit.

"The nature of graphite, sometimes called plumbago or black lead, is not generally understood. Eminent writers on friction have declared that graphite is the best natural lubricant known, and scientific and mechanical papers have advocated its use for many purposes. Incompetent, if not unscrupulous, parties have attempted to meet the demand by putting on the market graphite productions that are totally unfit for the uses specified.

"Graphite is one of the forms of carbon. It is not affected by heat or cold or any known chemical. As it comes from the mine, however, it contains from 50 to 80 per cent. of silica, sulphur and other impurities, and the process of completely freeing the graphite from impurities requires very expensive machinery and the most skillful manipulation. Only manufacturers having such facilities can hope to produce an absolutely pure article. The impurities in much of the graphite now in the market take on the appearance of graphite by contact, and such impurities are sometimes undetected even by the expert, unless chemical tests are employed. This is especially true of amorphous graphite, commonly called black lead, which is graphite without any particular form and usually mixed with clay.

"Pure graphite, and even black lead, is useful in many ways, as perusal of our catalogues will show; but, to be useful in the highest degree, the graphite should be carefully selected with a view to the use intended. Graphite suitable for lead pencils is not the most suitable for lubricating, although it has lubricating qualities. Again, graphite suitable for stove polish would not answer for crucibles, although it might be equally pure and stand the heat equally well.

"Graphite varies greatly in its construction and usefulness, and the best results are only brought about through experience, knowledge and proper mechanical facilities.

"We are miners as well as importers of graphite in all its forms, and use no graphite that we do not either mine or prepare. We have not only every facility in the way of machinery and chemists, but also the records and experience beginning in 1827, when Joseph Dixon first began the manufacture of stove polish and crucibles. We, therefore, know and guarantee the purity of our productions, and buyers of the Dixon products can feel assured not only of the *purity* of the graphite used, but also that the *proper* graphite has been used."

FOR SALE.

One 10 H. P. Baxter Motor.
One 5 " " "
One 3 Arc Light Dynamo.
One 25 Incandescent Light Dynamo, 220 volts.
One 15 " " " 110 "
One 2 H. P. Motor, 500 volts.
One 1 " " " 500 "

All in good condition.

A. H. ARP,
511 Fifteenth Street,
MOLINE, ILL.

MACHINERY IN STOCK.

Engine Lathes, 10 in. x 4 ft.; 11 in. x 5 ft.; 12 in. x 6 ft.; 14 in. x 6 ft.; 16 in. x 6 ft.; 18 in. x 8 ft.; 20 in. x 8 ft., with tapes attachment; 22 in. x 12 ft. and 14 ft.; 24 in. and 26 in. x 16 ft.; 30 in. x 10 ft. and 18 ft.; 36 in. and 38 in. x 20 ft.; 42 in. x 12 ft.; 27 in. x 32 ft.; 88 in. x 31 ft.; 96 in. x 30 ft. Fox Lathes, 13 in. x 5 ft.; 14 in. x 5 ft.; 15 in. x 6 ft.; 18 in. x 6 ft. Turret Lathes, 12 in. x 5 ft.; 14 in. x 5 ft.; 15 in. and 16 in. x 6 ft.; 18 in. x 6 ft.; 36 in. x 8 ft.

Planers, 16 in. x 16 in. x 3 ft.; 20 in. x 20 in. x 4 ft.; 24 in. x 24 in. x 6 ft.; 30 in. x 30 in. x 6 ft.; 36 in. x 36 in. x 10 ft.; 42 in. x 42 in. x 12 ft.; 44 in. x 48 in. x 22 ft.; 60 in. x 49 in. x 24 ft.

Friction Shapers, 15 in., 16 in., 20 in., 22 in., 32 in.

Crank Shapers, 6 in., 8 in., 10 in., 12 in., 13 in., 16 in., 17 in., 20 in., 24 in., 28 in.

Screw Machines, Nos. 1, 2, 3, 4, with or without Wire Feed.

Screw Machines, Nos. 5, 6, 7, 8, Power Feed.

Presses, Nos. 51, 52, 53, Ferracute; Nos. 1, 2, 3, Stiles & Parker.

5 Lincoln Pattern Millers, No. 2.

Hand Millers, Nos. 1 and 2. 3 Cam Cutters.

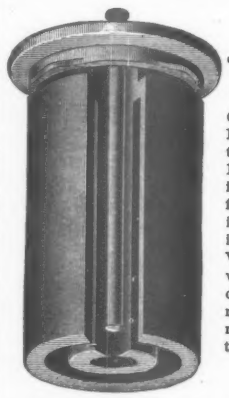
Bolt Cutters, ¼ in. to 1 in., ½ in to 2 in.

2 Profiling Machines. 1 36 in. and 48 in. Gear Cutter.

C. D. and E. Horizontal Boring Machine. Newark Machine Tool Co.

Send for List of New and Second-Hand Machinery in Stock.

PRENTISS TOOL & SUPPLY CO., P. O. Box 3362, 115 Liberty Street, New York.
59 South Canal St., Chicago, Ill.



THIS is a cut of the Law Battery Double Cylinder Carbon Element attached to cover with zinc. It has 147 square inch carbon surface. The element is everlasting and is so guaranteed. Why use a battery with a chemical depolarizer that needs frequent renewal of the negative element?

LAW BATTERY COMPANY,
85 JOHN STREET, N. Y.

Judicial Sale of Electric Street Railway.

BARROW vs. ST. CATHARINES, MERRITTON AND THOROLD STREET RAILWAY COMPANY.

By virtue of the judgment herein and the order for immediate sale, there will be sold, with the approbation of J. E. O'Reilly, Esquire, Local Master at Hamilton, at the Grand Central Hotel, St. Catharines, on Saturday, the 28th day of May, A.D. 1892, at noon, by S. Robinson & Son, Auctioneers, the undertaking known as "The St. Catharines, Merritton and Thorold Street Railway," including the rolling stock and equipments thereof, full details and particulars of which can be obtained on application to the Vendor's Solicitors.

The undertaking consists of a valuable water-power, with the necessary machinery for generating electricity, at Merritton, over six miles of track and wires, cars, motors, office, sheds, etc. There is estimated to be a surplus of 200 horse-power over the requirements of the railway, which can be utilized for supplying power and light to manufactories, residences, etc.

Terms: 10 per cent. on the day of sale, and the balance without interest 30 days thereafter. The property will be sold subject to a reserved bidding fixed by the Master.

Further particulars and conditions of sale may be obtained on application to T. E. Nihan, Receiver and Manager, St. Catharines, or to Bruce, Burton & Bruce, Canada Life Chambers, Hamilton, Ontario, Canada, or to

NESBITT, BICKNELL & GAULD,
Vendor's Solicitors.
Canada Life Chambers,
Hamilton,
Ontario, Canada.

J. E. O'REILLY,
Local Master at Hamilton.

Robb MacKie,

CONSULTING ELECTRICAL ENGINEER,

Neave Building,

CINCINNATI, O.

WANTED TO BUY.

High-speed Engines, Dynamos, Boilers and Electrical Apparatus. Must be in good condition. Give full description, terms, price in first letter. We refer to Bradstreet, Dun, Denver National Bank.

F. P. ARBUCKLE,
Highlands, Denver, Colo.

AN ELECTRICAL LIBRARY.

OPPORTUNITY FOR BEGINNERS.

A Comprehensive, Carefully Selected, yet Inexpensive, List of Instructive Electrical Books.

In response to the many inquiries from all parts of the country as to the best books for those who are desirous of becoming posted in the rudiments of Electricity in its various branches, and in an endeavor to afford beginners as wide a range of reading as possible for a comparatively small outlay, the Book Department of the **ELECTRICAL REVIEW PUBLISHING COMPANY** makes the following offer:

We will send by *express, prepaid,* on receipt of **$15.00,** fourteen books by the most popular authors, especially adapted for a course of elementary reading, including the **ELECTRICAL REVIEW** for one year, as follows:

PRACTICAL ELECTRICITY, - By *Ayrton*
ELEMENTS OF ELECTRIC LIGHTING, - - - - - By *Atkinson*
DYNAMO TENDER'S HAND BOOK, By *Badt*
INCANDESCENT WIRING HAND-BOOK, - - - - - By *Badt*
THE DYNAMO, - - By *Bottone*
ELECTRIC BELLS AND ALL ABOUT THEM, - - By *Bottone*
ELECTRICITY FOR ENGINEERS, By *Desmond*
THE TELEPHONE, - - By *Dolbear*
ALTERNATE CURRENT MACHINERY, - - - - - By *Kapp*
INCANDESCENT ELECTRIC LIGHTING, - - - - - By *Latimer*
A, B, C, OF ELECTRICITY, By *Meadowcroft*
ELECTRICITY SIMPLIFIED, - By *Sloane*
ELECTRICIANS' PRIMERS (Theory and Practice), 2 Volumes.
ELECTRICAL REVIEW, - ONE YEAR. (52 Numbers.)

The price of the above list is $18.00, *and, aside from the saving on cost, the student has the benefit of an unexcelled selection from which he can derive the best practical results.*

REMEMBER: $15.00 buys all of the above, delivered to your office or residence.

Address:

ELECTRICAL REVIEW,
13 Park Row, N. Y.